DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

REPLY TO
ATTENTION OF

July 30, 2012

Engineering/Planning Division
Geo-Environmental Engineering Branch

Ms. Lynne Jennings
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Boston, Massachusetts 02109-3912

Mr. Len Pinaud
Massachusetts Department of Environmental Protection
20 Riverside Drive
Lakeville, Massachusetts 02347

Re: Impact Area Groundwater Study Program
USEPA Region I Administrative Orders SDWA 1-97-1019 & 1-2000-0014
Final J-2 Range Eastern and J-2 Range Northern Interim Environmental Monitoring report, August 2010 through July 2011, dated July 2012

Dear Ms. Jennings and Mr. Pinaud:

On behalf of the Army National Guard Impact Area Groundwater Study Program (IAGWSP), the U.S. Army Corps of Engineers (USACE) is pleased to provide the enclosed Final J-2 Range Eastern and J-2 Range Northern Interim Environmental Monitoring report, August 2010 through July 2011, dated July 2012. Comments were received from U.S. Environmental Protection Agency (EPA) in a letter dated February 8, 2012, and from the Massachusetts Department of Environmental Protection (MassDEP) in a letter dated January 12, 2012. Approval of the MOR was received from the EPA in a letter dated July12, 2012.

Please contact Dave Hill of the IAGWSP office or Mark Anderson of USACE if there are any questions.

Sincerely,

Anthony T. Mackos, P.E.
Chief, Engineering/Planning Division

Enclosures

EPA 1 copy and 1 CD
MassDEP 1 copy and 1 CD

Copy Furnished:

IAGWSP: B. Gregson (letter only), Dave Hill (1 copy), and M. Goulet (5 copies and 2 CD)
USACE: Jay Ehret (1 copy), Mark Anderson (1 copy), Ken Heim (1 copy), and Marie Wojtas (1 copy & 1 CD)
EPA: Jane Dolan (1 copy), MMR Field Office (1 copy and 1 CD), Erin Sanborn (1 CD)

Impact Area Groundwater Study Program

FINAL

J-2 Range Eastern
Interim Environmental Monitoring Report
August 2010 through July 2011

J-2 Range Northern
Interim Environmental Monitoring Report
August 2010 through July 2011

Camp Edwards
Massachusetts Military Reservation
Cape Cod, Massachusetts

July 2012

Prepared for:
Army National Guard
Impact Area Groundwater Study Program
Camp Edwards, Massachusetts

Prepared by:
U.S. Army Corps of Engineers
New England District
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Concord, Massachusetts

Disclaimer

This document has been prepared pursuant to government administrative orders (U.S. EPA Region I SDWA Docket No. I-97-1019 and 1-2000-0014) and is subject to approval by the U. S. Environmental Protection Agency. The opinions, findings, and conclusions expressed are those of the authors and not necessarily those of the Environmental Protection Agency.

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Acronyms and Abbreviations

3-D	three-dimensional
cf	cubic feet
COC	contaminant of concern
Eff	effluent
ETI	extraction, treatment, and infiltration
GAC	granular activated carbon
gpm	gallons per minute
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
Inf	influent
IX	ion exchange
J	estimated value
MMR	Massachusetts Military Reservation
msl	mean sea level
MTU	modular treatment unit
ND	nondetect
RRA	rapid response action
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
TOM	top of the groundwater mound
U	non-detected value
µg/L	micrograms per liter

1.0 INTRODUCTION

This interim annual environmental monitoring report for the J-2 Range Eastern plume provides analyses of plume dynamics and hydraulics including assessment of model-predictions against observed behavior; monitoring program effectiveness operational aspects of the rapid response action (RRA) extraction, treatment, and infiltration (ETI) system; and the in-plant effectiveness at treating extracted groundwater. Results of the two groundwater sampling rounds that were collected in September/October 2010 and March 2011 along with the results of the plant monitoring from August 2010 through July 2011 are discussed.

The J-2 Range is located adjacent to and southeast of the Massachusetts Military Reservation (MMR) Impact Area, and is the northernmost of the four former training ranges that comprise the Southeast Ranges (Figure 1-1). The Southeast Ranges are former military training ranges and defense contractor test ranges that operated from 1935 to 1997. The J-2 Range was used from 1935 through the 1980s.

1.1 Purpose

The J-2 Range Eastern RRA ETI system was implemented to facilitate contaminant mass removal from groundwater and control plume migration prior to selection of a final remedy. The purpose of this report is to document the following activities:

- Assessment of system operations;
- Assessment of the treatment system's effectiveness at removing perchlorate and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) from groundwater;
- Evaluation of hydraulic conditions to assess aquifer response to pumping;
- Assessment of the chemical monitoring results;
- Comparison of model-predicted and observed results;
- Recommendations for future monitoring activities in the plant, chemical, and/or hydraulic monitoring networks.

1.2 Background

The J-2 Range Eastern plume consists of groundwater contaminated with levels of perchlorate above the Massachusetts maximum contaminant level of 2 micrograms per liter (µg/L) and the EPA Health Advisory of 15 µg/L, and levels of RDX above the risk-based concentration of 0.6 µg/L, and the EPA Health Advisory of 2 µg/L. The perchlorate and RDX plumes consist of multiple plumelets that have sources located near the center of the J-2 Range. The main perchlorate plume (above 2 µg/L) extends approximately 5,000 feet downgradient from the J-2 Range and the width of the main perchlorate lobe is approximately 1,000 feet. The main RDX plume (above 0.6 µg/L) also extends approximately 5,000 feet downgradient from the range.

Sampling completed in September/October 2010 and March 2011 was conducted in accordance with the Final J-2 Range Eastern System Performance Monitoring Plan (ECC 2008c) and Final J-2 Range Eastern Plume 6- Month Interim Environmental Monitoring Report (ECC 2010). Wells sampled under the plan, frequency of analysis, and tested parameters are presented in Table 1-1. The explosives and perchlorate sample locations are depicted in Figure 1-2. Monitoring wells MW-367M1 and M2 were not, and will no longer be, included in the monitoring program at the homeowner's request. There were no other deviations from the chemical monitoring plan during this reporting period.

2.0 J-2 RANGE EASTERN PLUME TREATMENT FACILITIES AND WELLFIELD OPERATING CONDITIONS

This section describes the overall J-2 Range Eastern ETI system configurations, the operational history of the ETI systems and the in-plant effectiveness of the treatment process from August 2010 through July 2011.

2.1 J-2 Range Eastern Plume ETI System

The J-2 Range Eastern plume ETI system consists of three extraction wells (J2EW0004, J2EW0005, J2EW0006), four modular treatment units (MTU), and three infiltration trenches (Figure 2-1). Water extracted from J2EW0004 is treated at MTU J and water extracted from J2EW0005 is treated at MTUs H and I. Water treated at MTUs J, H and I, is returned to the aquifer through infiltration trenches located along Wood Road. Water extracted from J2EW0006 is treated at MTU K and returned to the aquifer through an infiltration trench located adjacent to Greenway Road.

Each MTU is housed within an 8-foot by 40-foot shipping container and is designed to effectively remove perchlorate and explosives compounds from groundwater at influent flow capacities of 125 gallons per minute (gpm). The design flows for the three extraction systems are:

- MTU J system: 90 gpm
- MTUs H and I systems: 210 gpm
- MTU K system: 125 gpm

The water treatment system housed within each of the MTUs is described by the process flow diagram shown on Figure 2-2. The treatment train for the groundwater consists of ion exchange (IX) to remove perchlorate, and then granular activated carbon (GAC) adsorption to remove explosives compounds. Each MTU contains two parallel sets of three pressure vessels: an IX unit followed by a primary and then secondary GAC unit. The lead GAC vessel provides the initial stage of treatment for the removal of explosives compounds, and the secondary, or guard GAC vessel provides backup capacity, ensuring that any breakthrough of contaminants from the first two stages of treatment (IX and GAC) will be captured prior to discharge. Each IX vessel contains 29 cubic feet (cf) of resin for a total capacity of 58 cf per MTU. Each GAC vessel has a capacity of 1,000 pounds of GAC, for a total four-vessel capacity of 4,000 pounds.

The operation of the ETI system for the 12 month period of August 2010 through July 2011 is described in the following sections.

2.2 J-2 Range Eastern Plume ETI System Operating History

The following discussion includes an overview and a summary of operations and maintenance of the system.

2.2.1 MTU J System Operations and Maintenance Summary

The MTU J ETI system has a design flow rate of 90 gpm. The MTU J ETI system began full-time operation on 11 September 2008 and has operated reliably with an “up time” of 98.6% since system start-up. Up-time is a measure of the MTU J system continuity of operation and is defined as the number of hours that groundwater is pumped from the extraction well and is actively treated during a given time period divided by the number of elapsed hours during the period (expressed as a percentage).

During this reporting period, from 1 August 2010 through 31 July 2011, the MTU J system had an up-time of 97.6%; the system was down for 211.65 hours out of 8736 elapsed hours. This downtime was comprised of: 74.63 hours due to three unplanned shutdowns for weather-related power outages; 44.20 hours for treatment media replacement; and 92.82 hours of downtime associated with Hurricane Earl and a computer error that delayed system restart after the hurricane.

2.2.2 MTUs H and I System Operations and Maintenance Summary

The MTUs H and I ETI systems began full-time operations on 11 September 2008 at a design flow rate of 210 gpm (or 105 gpm for each MTU). The system has operated reliably with an up-time of 98.4% since system start-up.

During this reporting period, from 1 August 2010 through 31 July 2011, the MTU H&I systems had an up-time of 97.9%. During this period, MTUs H&I were down for 185.45 hours out of 8736 elapsed hours. This downtime was comprised of: 80.28 hours due to three unplanned shutdowns due to power supply interruptions; 61.97 hours shutdown for treatment media replacement; 22.83 hours due to a high pressure alarm at the system influent in May 2011; and 20.37 hours shutdown due to Hurricane Earl.

2.2.3 MTU K System Operations and Maintenance Summary

The MTU K ETI system has a design flow rate of 125 gpm. The MTU K ETI system began full-time operation on 11 September 2008 and has operated reliably with an up-time of 98.2% since system start-up.

During this reporting period the MTU K system had an up-time of 96.12%. MTU K was down for 339.38 hours out of 8736 elapsed hours. This downtime was comprised of: 98.58 hours from three unplanned shutdowns due to power supply interruptions; 92.93 hours shutdown for treatment media replacement; 127.22 hours due to mechanical maintenance, most notably for four days to replace a faulty safety valve in December 2010; and 20.65 hours shutdown due to Hurricane Earl.

Table 2-1 and Figure 2-3, a through c, provide summaries of the downtime associated with this reporting period for each of the modular units.

3.0 J-2 RANGE EASTERN ETI SYSTEMS PERFORMANCE RESULTS

The purpose of the ETI system performance evaluation is to assess trends in the performance of the treatment system and effectiveness of the system at treating the contaminants in the J-2 Range Eastern plume.

3.1 In-Plant Monitoring

Sampling frequencies are as follows at each of the J-2 Eastern modular treatment units (H, I, J, K):

- Monthly for perchlorate and explosives at the influent (INF);
- Monthly for perchlorate at a sampling location after the ion exchange units (MID-1);
- Monthly for perchlorate at a sampling location after the lead GAC unit (MID-2) after perchlorate breakthrough of the ion exchange unit;
- Monthly for explosives at MID-2 (after the lead GAC unit), and
- Monthly for perchlorate and explosives at the effluent sample location (EFF).

Note that the influent sampling location for MTUs H and I are before the groundwater is split into two streams and sent to the individual MTUs. Thus, there is only a single monthly influent sample collected for the MTU H and I systems. The method for calculating the mass removal (i.e., mass extracted from the aquifer) values presented in the following sections is the monthly influent concentration (C) multiplied by average monthly groundwater extraction rate (Q) multiplied by time of operation (T). The average flow rate, Q, is adjusted to incorporate system down time, if any (Table 2-1). For example at MTU J, Figure 3-1 plots the influent concentration (C) on a monthly basis, Figure 3-2 plots the influent volume treated (Q*T), and Figure 3-3 plots the calculated mass removed on a monthly basis (C*Q*T).

All in-plant chemical sampling was conducted in accordance with the Final J-2 Range Eastern System Performance Monitoring and Evaluation Plan (ECC 2008). The sampling locations are shown in Figure 2-2. Analytical results, including COCs and field parameter measurements are presented in Tables 3-1 through 3-3 for MTUs J, H&I, and K, respectively.

No influent and effluent samples were analyzed for geochemical parameters (inorganic wet chemistry methods and total metals) as had been done in June 2009 and reported previously. The data collected in June 2009 established that process objectives, particularly attaining effluent criteria, were being met. No subsequent sampling for geochemical parameters is scheduled, but may be performed on an as needed basis in the future.

3.2 MTU J Operational Results

3.2.1 Influent

The concentration of COCs (perchlorate and RDX) in the system influent remained relatively stable during the reporting period (Table 3-1). Influent explosives concentrations were slightly lower than in the last reporting period. RDX concentrations ranged from non-detect (i.e., less than 0.25 µg/L) to 0.346 µg/L, and octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) ranged from 0.459 µg/L to 0.664 µg/L. Perchlorate ranged from 0.951 to 1.29 µg/L during this reporting period. A graph of influent concentration versus time can be found on Figure 3-1.

3.2.2 Breakthrough of Contaminants of Concern

Breakthrough of HMX occurred from the primary GAC vessel on 6 February 2011 at MTU J at 0.253 µg/L. A GAC exchange was conducted on 7 March 2011. There was no breakthrough of perchlorate at the ion exchange vessels or RDX from the GAC during the reporting period.

3.2.3 Total Groundwater Volume Treated

During this reporting period, MTU J successfully treated 45.8 million gallons of contaminated groundwater. The total volume treated since startup is 133.7 million gallons (Figure 3-2, Table 3-4).

3.2.4 Mass Removals

During this reporting period, the MTU J ETI system removed 0.45 pounds of perchlorate, 0.22 pounds of HMX, and 0.11 pounds of RDX from the J-2 Range Eastern plume. The cumulative mass removed since startup is shown in Figure 3-3 and Table 3-4.

3.2.5 Sampling Frequency Evaluation

The monthly sampling described in Section 3.1 has been adequate to monitor for filter media breakthrough and to ensure that the plant effluent meets the discharge requirements. The detailed description of the sampling schedule to be continued is presented in Table 3-5.

3.3 MTUs H and I Operational Results

3.3.1 Influent

During the reporting period, influent concentrations of explosives were relatively consistent with the concentrations from the previous reporting period. As shown in Figure 3-4, however, the concentration of RDX appeared to decrease slightly over the year. Influent RDX concentrations ranged from 0.30 µg/L to 0.91 µg/L. Influent HMX concentrations fluctuated slightly ranging from ND to 0.648 µg/L. Perchlorate, which had increased by about 1.5 µg/L during the previous reporting period, declined steadily through this reporting period. Influent concentrations of perchlorate ranged from 3.97 µg/L at the beginning of the reporting period to 2.48 µg/L at the

end. Analytical results are presented in Table 3-2. A graph of influent concentration versus time is shown on Figure 3-4.

3.3.2 Breakthrough of Contaminants of Concern

Breakthrough of RDX occurred from the primary GAC vessel on 5 October 2010 at MTU H at 0.250 µg/L. A GAC exchange was conducted on 27 October 2010.

3.3.3 Total Groundwater Volume Treated

For this reporting period, MTUs H and I successfully treated 107.8 million gallons of contaminated groundwater. The total volume treated since startup is 314.8 million gallons (Figure 3-5 and Table 3-4).

3.3.4 Mass Removals

During this reporting period, MTUs H&I removed 2.81 pounds of perchlorate, 0.56 pounds of RDX, and 0.24 pounds of HMX from the J 2 Range Eastern plume. The cumulative contaminant mass removed since startup is shown in Figure 3-6 and in Table 3-4.

3.3.5 Sampling Frequency Evaluation

The monthly sampling described in Section 3.1 has been adequate to monitor for filter media breakthrough and to ensure that the plant effluent meets the discharge requirements. The detailed description of the sampling schedule to be continued is presented in Table 3-5.

3.4 MTU K Operational Results

3.4.1 Influent

During the reporting period no HMX was detected in influent samples. RDX influent concentrations were relatively stable during the period, ranging from a high of 0.903 µg/L in August 2010 to a low of 0.591 µg/L in April 2011. Influent concentrations of perchlorate declined very gradually during this reporting period, continuing a trend that began in October 2009. During this period, perchlorate concentrations ranged from a high of 0.484 µg/L in November 2010 to a low of 0.408 µg/L in May and June of 2011. Analytical results can be found on Table 3-3. A graph of influent concentration versus time can be found on Figure 3-7.

3.4.2 Breakthrough of Contaminants of Concern

No breakthrough of perchlorate occurred during the reporting period at MTU K. However, breakthrough of RDX occurred from the primary GAC vessel on 7 October 2010 at 0.326 µg/L and on 10 March 2011 at 0.254 µg/L. GAC exchanges were conducted on 17 November 2010 and 4 April 2011.

3.4.3 Total Groundwater Volume Treated

During this reporting period, MTU K ETI successfully treated 62.7 million gallons of contaminated groundwater. The total volume treated since startup is 185.3 million gallons (Figure 3-8 and Table 3-4)

3.4.4 Mass Removals

During this reporting period, MTU K removed 0.23 pounds of perchlorate, and 0.37 pounds of RDX from the J 2 Range Eastern plume. Although some HMX may have been removed by the system, since no HMX was measured in the influent, no quantification was possible. The cumulative contaminant mass removed since startup is presented in Figure 3-9 and Table 3-4.

3.4.5 Sampling Frequency Evaluation

The monthly sampling described in Section 3.1 has been adequate to monitor for filter media breakthrough and to ensure that the plant effluent meets the discharge requirements. The detailed description of the sampling schedule to be continued is presented in Table 3-5.

4.0 HYDRAULIC PERFORMANCE MONITORING

Hydraulic monitoring synoptic events were conducted for the J-2 Range Eastern plume on 13 September 2010 and 14 March 2011. The purpose of the hydraulic monitoring is to evaluate system performance through analysis of the aquifer's hydraulic response to system operations. In all cases throughout this annual, report mean sea level (msl) refers to the zero foot elevation of the NGVD29 datum.

4.1 Synoptic Water Level Measurements

The 2010 and 2011 synoptic events were conducted to help determine changes in groundwater and flow patterns in the vicinity of the J-2 Range Eastern system. Each of the three extraction wells were operating at their design rates during these synoptic events and water level measurements were collected at all wells specified in the J-2 Range Eastern system performance monitoring plan (ECC 2008c). The hydraulic monitoring network is shown in Figure 4-1. Table 4-1 lists the water level monitoring network and Table 4-2 presents water level data collected on 13 September 2010 and 14 March 2011 and includes observed changes

4.2 J-2 Range Eastern Groundwater Level Analysis

The water levels measured on 13 September 2010 and 14 March 2011 were analyzed for potential data anomalies and errors. The water level measurements obtained from well J2MW-01PZ was anomalous for the 13 September 2010 event but was realistic for the 14 March 2011 event so the data from the 13 September 2010 event at J2MW-01PZ was not used for water level contouring or flow field analysis but the 14 March 2011 event data was used.

The water level data from the 13 September 2010 event ranged from 71.50 feet mean sea level (msl) at MW-436M2 in the northern end of the study area to 75.60 feet msl at MW-128M2 in the southern end of the monitoring network (Figure 4.1). The horizontal gradient calculated across the J-2 Range Eastern plume for the 13 September 2010 synoptic event was approximately 0.00054 feet/foot. The water level data from the 14 March 2011 synoptic event ranged from 69.33 feet msl at MW-436M1 in the northern end of the study area to 73.34 feet msl at MW-128M2 in the southern end of the monitoring network. The horizontal gradient calculated across the J-2 Range Eastern plume for the 14 March 2011 synoptic event is 0.00053 feet/foot.

The water level data from monitoring wells with screen mid-points from +8.74 to -124.38 feet msl were used to construct groundwater potentiometric maps (Figures 4-2 and 4-3). These wells are screened at a similar elevation to the extraction wells which are screened from -8 to -124 ft msl. Water levels were not measured at the extraction wells. However, to represent the true flow nature of the system, water levels at the extraction wells were estimated based on regional trend analysis and information obtained as part of system start-up. The well screens selected for use in the development of a potentiometric surface generally coincide with elevations of perchlorate and RDX plumes. The potentiometric analyses were aided by using SURFER (Version 9), a geo-mapping software package. Monitoring wells bolded in Figures 4-2 and 4-3

indicate the wells used to develop the potentiometric surface map. The other data collected in the cluster are used to assess vertical gradients.

As shown in Figures 4-2 and 4-3, the regional groundwater flow direction, based on water level measurements at the interval from +8.74 to -124.38 feet msl, is towards the northeast with convergent flow near the three extraction wells due to the hydraulic stress of pumping. The flow fields converge near the extraction wells, reflecting inward horizontal hydraulic gradients for the interval represented. The horizontal hydraulic gradient is lower in the southern portion of the J-2 Range Eastern plume, which measures approximately 0.00035 ft/ft, due to the proximity to the top of the groundwater mound (where the water levels are flat and the horizontal hydraulic gradient is lower) and increases away from the mound from south to north. The only exception to the flow of contaminated groundwater being toward the extraction wells is in the area of well MW-215, where elevated groundwater levels suggest flow toward the northeast. Groundwater level contours in the area of well MW-215 are a reflection of drawdown at the J2EW0004 extraction well and even though the plume southeast of this well is not anticipated to be captured, groundwater modeling indicates that it will attenuate to a perchlorate concentration of less than 2 µg/L by 2015. The affect of the elevated groundwater level on contaminant transport will be further evaluated in the RI/FS for the J-2 Range. Overall, the flow field analysis indicates gradients are generally in the direction of the extraction wells at plume elevation.

4.3 Regional Groundwater Level Changes

The 13 September 2010 and 14 March 2011 water level data were analyzed and compared with the earlier synoptic water level measurements under operational conditions to evaluate long-term changes in water levels and identify trends (Table 4-2). The change in groundwater level between 1 September 2009 and 13 September 2010 ranged from +4.10 feet to +5.58 feet and averaged 4.49 feet; the change in groundwater level between 3 March 2010 and 14 March 2011 ranged from +0.44 feet to +0.92 feet and averaged +0.70 feet.

These increases in water levels are consistent with regional increases in water levels for this same time frame as measured at several USGS monitoring wells where water level measurements are recorded every 15 minutes by a pressure transducer data logging system. This data is available on the USGS websites:

- http://waterdata.usgs.gov/nwis/dv/?site_no=414124070311401&agency_cd=USGS&referred_module=gw
- http://waterdata.usgs.gov/nwis/dv/?site_no=414139070311501&agency_cd=USGS&referred_module=gw
- http://waterdata.usgs.gov/nwis/dv/?site_no=414159070310501&agency_cd=USGS&referred_module=gw

- http://waterdata.usgs.gov/nwis/dv/?site_no=414219070313601&agency_cd=USGS&referred_module=gw

The four USGS wells provide a detailed history of groundwater levels near the top of the regional groundwater mound. The USGS wells are superior to using J-2 Range monitoring wells because of their long data history and because the frequency of data collected at the USGS wells is once every 15 minutes while the water levels at the J-2 Range wells are only measured just a few times per year.

4.4 J-2 Range Eastern System Performance Evaluation

Water levels among the well clusters were used to calculate the vertical gradients within the J-2 Eastern monitoring network. The table presents vertical gradients within the J-2 Eastern Range monitoring network. The Table presents the vertical gradients for the two semi-annual synoptic events obtained during the reporting period and includes baseline (non-pumping) and operational conditions. The results indicate that the extraction wells have had the desired effect on the aquifer system. The hydraulic gradient changes at the near-field wells (J2MW05M1, M2, J2MW-02M1, M2, PZ, J2MW-01M1, M2, MW-393D, M1, M2, J2MW-03M2, and PZ) showed either reverse or enhanced flow in the direction of the extraction well screens in response to pumping. The hydraulic gradients exhibited at wells farther from the extraction wells did not change significantly between the ambient and the operational condition. The vertical gradient analysis for the site-wide monitoring network only provides very limited insight into the system performance, partly because of the highly conductive nature of the aquifer system and the significantly aquifer thickness relative to the pumping interval. .

5.0 CHEMICAL MONITORING

An annual sampling event was conducted in September/October 2010, and a semi-annual event was conducted in March 2011. The current chemical monitoring network is presented in Table 1-1, sample locations are depicted on Figure 1-2 and sample results are presented in Table 5-1. Figure 5-1 depicts the plan view of the perchlorate plume and the lines of cross-sections and Figures 5-2 through 5-5 depict perchlorate concentrations along the cross-sections. Figure 5-6 depicts the plan view of the perchlorate plume with graphs of historical perchlorate concentrations at selected wells.

Figure 5-7 depicts the plan view of the RDX plume and the lines of cross-sections and Figures 5-8 through 5-11 depict RDX concentrations along the cross-sections. Figure 5-12 depicts the plans view of the RDX plume with graphs of historical RDX concentrations at selected wells.

Sample collection, and field monitoring equipment calibration and maintenance, was conducted in accordance with approved procedures (ECC 2007a).

5.1 Monitoring Results

The two primary site related contaminants in the J-2 Range Eastern plume are perchlorate and RDX. Although there is a high degree of commingling of the perchlorate and RDX contamination within the J-2 Range Eastern plume, there is some variability in the mass distribution of perchlorate and RDX within the plume. This is largely due to the fact that the plume resulted from releases at multiple locations on the J-2 Range over a time frame spanning several decades.

The perchlorate detections are more widespread than the RDX detections. The vertical perchlorate distribution is shown on cross sections B-B', C-C', D-D', and E-E' (Figures 5-2 through 5-5). Select perchlorate trends are also shown on Figure 5-6. The vertical RDX distribution is shown on cross sections B-B', C-C', D-D', and E-E' (Figures 5-8 through 5-11). Select RDX trends are also shown on Figure 5-12.

The representation of concentrations and contaminant distributions shown in these figures and discussed in this section were developed conservatively using both profile data and fixed well data collected over time, and in consideration of the groundwater flow trajectories inferred from the groundwater elevation contours that have been mapped within the study area. Monitoring results were used to develop interpretations of current plume size and shape; however, it is important to consider that the spatially limited monitoring well data requires that concentrations be forward migrated in order to fill in areas without monitoring wells and there some high concentrations may be interpreted in areas without recently measured data. The geology depicted on the cross sections was based on available drilling information and professional judgment.

5.1.1 Perchlorate

As noted above, there are multiple sources of contamination at the J-2 Range Eastern plume that have resulted in a heterogeneous plume. The J-2 Range Eastern plume (above 2 µg/L) was mapped as a main lobe and three, smaller, lateral lobes. The main lobe of the perchlorate plume (above 2 µg/L) is approximately 4,500 feet long and approximately 1,100 feet wide at its widest point. There are also three, smaller, perchlorate lobes located on either side of the main lobe. The current conceptual understanding of the J-2 Range Eastern plume is very similar to the understanding at the time the ETI system was designed (ECC 2008), with some minor changes.

Southeastern Lobe

Perchlorate concentrations have steadily declined at MW-319M1 in the southeastern lobe and have never been above 2 µg/L over 13 sampling events dating to October 2005. Since April 2008, perchlorate concentrations at MW-319M1 have been consistently below 1 µg/L. Perchlorate concentrations have remained relatively constant at MW-319M2 ranging from a low of <1 µg/L in 2009 to a high of 3.7 µg/L in 2004; however, concentrations have been less than 2 µg/L since 2010.

Eastern Lobe

Perchlorate concentrations in the eastern lobe, defined by perchlorate detections at MW 310M1, which have steadily declined since startup of the ETR system with the most recent concentration being 1.59 µg/L (March 2011). Concentrations in well MW-215M2 that define the northern edge of this lobe have historically been between 1 and 2 µg/L but have gradually risen since 2006, reaching 2.1 µg/L in 2009 and 4.0 µg/L in September 2010.

Western Lobe

There have been no detections of perchlorate in monitoring wells in the western lobe above 2 µg/L since 2005. Samples collected from MW-366M3/M2 since 2006 were usually ND at the detection limit of 1 µg/L under method E314.0. Most recently, perchlorate concentrations in MW-366M3/M2 have been 0.0434J µg/L and 0.38 µg/L, respectively, at the method reporting limit of 0.05 µg/L using method SW6860. Concentrations have been relatively stable in MW-366M1 with a perchlorate concentration reported at 1.02 µg/L in September 2010, which is a slight increase over the concentration of 0.604 µg/L measured in August 2009. Samples collected from downgradient monitoring wells (MW-381M1 and MW-381M2) have been ND since August 2005 at a detection limit of 1 µg/L. Most recently, perchlorate concentrations in MW-381M1/M2 have been 0.058 µg/L and 0.0118J µg/L, respectively, at the method reporting limit of 0.05 µg/L using method SW6860.These results likely indicate that the lobe has naturally attenuated to concentrations below 2 µg/L, although a depiction of a small area of concentrations above 2 µg/L, based on migrated data from 2005, has been retained in this plume depiction. Concentrations of perchlorate continue to decline in well MW-388M2 located upgradient of MW-366 to 0.677 µg/L (September 2010).

Beneath Source Area

Perchlorate concentrations beneath the source area of the main lobe have continued to decrease. The current perchlorate concentration beneath the source area is 2.1 µg/L (MW-307M3, March 2011); down from a historic high of 25.3 µg/L (April 2007). The groundwater sample collected from J2MW-05M2, located adjacent to extraction well J2EW0004, was 0.219 µg/L in October 2010, a continued indication of vertical thinning of the plume as a result of the extraction well stresses. Perchlorate concentrations at J2NW-05M2 may continue to be detected from this monitoring well because it is located within the capture zone of J2EW0004.

Main Lobe (Shallow and Deep Zones)

The conceptual understanding of the main lobe is that a high concentration core has bifurcated above and below fine strata, resulting in a shallow zone and a deep zone. The shallow zone (above elevation -50 feet msl) is primarily defined by recent perchlorate levels up to 54.8 µg/L at MW-368M2 and does not extend as far to the west or north as MW-339M2 (cross gradient to the west), deeper than MW-335M2 (downgradient and cross gradient to the west), or in shallow profile samples at J2MW-01 (downgradient). The deep zone (deeper than -65 feet msl), showed an increase in concentration from 48.5 µg/L (MW-368M1, September 2009) to 63.1 µg/L (September 2010) and appears to be wider than the shallow zone, with perchlorate concentrations recently reported as 0.594 µg/L in MW-335M1 (March 2011). Concentrations in MW-335M1 have declined considerably from 18.2 µg/L in March 2010. The higher concentrations (above 15 µg/L) do extend to well J2MW-01M2, where perchlorate was detected at 29.4 µg/L (September 2010). This well is located adjacent to the deeper screen of extraction well J2EW0005. The deeper zone appears to be beneath some low-hydraulic-conductivity units observed from approximately -45 feet msl to -65 feet msl at a number of locations in the middle of the plume (MW-368, J2MW-01, MW-335 and MW-339). The middle of the main lobe has narrowed slightly, based on a generally decreasing trend at MW-339M1 to below 2 µg/L since February 2009 (March 2011 – 0.861 µg/L).

Downgradient Lobe

The downgradient portion of the main perchlorate lobe thins considerably to approximately -90 to -110 feet msl in the vicinity of J2MW-04M1, where profile results did not detect perchlorate above the M1 screen, although the M1 screen, itself showed a slight decrease from 2.15 µg/L to 1.88 µg/L between February 2009 and March 2011. Recent results from J2MW-04M2 reported 0.056 µg/L (March 2011) and downgradient well MW-393M2 was 0.0246J µg/L (October 2010). These wells are screened from -52.7 to -62.7 ft msl and -61.5 to -71.5 msl, respectively.

5.1.2 RDX

The J-2 Range Eastern RDX plume (above 0.6 µg/L) consists of one main lobe and an isolated downgradient lobe. The main lobe is approximately 5,000 feet long and approximately 1,500 feet wide at the widest point. The current conceptual understanding of the J-2 Range Eastern plume is very similar to the understanding at the time the ETI system was designed (ECC 2008), with some minor changes.

Beneath Source Area

RDX concentrations in the upgradient portion of the plume have deceased to ND in two wells located beneath the source area; MW-307M3 and MW-228S. In contrast, RDX concentrations at MW-228M2, that have been ND since January 2006, have recently been measured at 0.826 µg/L (September 2010). In general, these results indicate there is very little mass continuing to leach from the source areas that contributed to the main lobe of the RDX plume but that anomalously high concentrations are still possible due to variations in source strength or availability.

Downgradient of the source area, concentrations in MW-321M2 decreased slightly from an anomalously high concentration of 1.3 µg/L (September 2009) to 0.516 µg/L (September 2010), which is again representative of concentrations measured since 2004. Concentrations in J2MW-05M2 were ND in the first sampling round in September 2009 and again in October 2010. This well is located adjacent to extraction well J2EW0004.

Main Lobe

In the middle of the plume, concentrations remained stable or decreased slightly in wells either above or below the low hydraulic conductivity units located near J2EW0005. RDX concentrations at MW-368M1/M2 were slightly higher (0.687J µg/L to 1.15 µg/L) from September 2009 to September 2010 at MW-368M1 and essentially unchanged (13 µg/L to 14.6 µg/L) in MW-368M2 between March 2010 and March 2011. In MW-335M1, concentrations dropped (0.462 µg/L to ND µg/L) from March 2010 to March 2011. Similarly, concentrations increased slightly at MW-324M1 (0.405 µg/L to 1.09 µg/L) between March 2010 and March 2011. Along the edge of the plume, RDX concentrations were unchanged at MW-215M2 (2.16 µg/L to 2.11 µg/L) from September 2009 to September 2010 (Figure 5-9). In J2MW-01M2 (adjacent to the deeper screen at J2EW0005), concentrations measured 2.97 µg/L in September 2010. This was the second sample collected from this well, and is an increase over the maximum detected profile result of 0.36 µg/L and over the concentration of 1.87 µg/L measured in September 2009. The increase in concentration likely represents an effect of pumping at the extraction well, which increased the groundwater flow/contaminant transport to the well. These results indicate the RDX plume is narrowing slightly at the edges and vertically as contaminated groundwater is being drawn into the extraction well.

Downgradient Lobe

In the downgradient portion of the plume, results from J2MW-04M2 have been ND for five consecutive rounds and concentrations have decreased from 0.86 µg/L to ND (three consecutive rounds) between April 2008 and October 2010 in MW-393M2. Similarly, concentrations have decreased from 0.38 µg/L to ND (three consecutive rounds) between April 2008 and October 2010 in MW-393M1. At MW-351M2, RDX concentrations have decreased from 0.217 µg/L to ND (four consecutive rounds) between February 2009 and March 2011. The data seems to indicate that the shallow RDX plume may be discontinuous in the area of J2MW-

04M2 and the downgradient extraction well J2EW0006. The discontinuous nature of the plume may be a result of intermittent source releases.

RDX concentrations in downgradient well MW-436M2 continue to be ND and are consistent with the previous conceptualization of this zone of contamination.

5.1.3 Other Explosives

In addition to perchlorate and RDX, HMX was detected in sixteen samples collected from six monitoring wells. The EPA health advisory for HMX is 400 µg/L and the MCP GW-1 criteria is 200 µg/L. The maximum concentration detected was 5.3 µg/L at MW-321M2. There were no other explosives compounds detected in the groundwater samples collected (Table 5-1).

6.0 GROUNDWATER MODELING

Various modeling tools were used to evaluate the performance of the J-2 Range Eastern ETI system and the J-2 Range Eastern plume. Modeling-predictions from the revised perchlorate and RDX plume shells developed with data through March 2009 (model date 2009.25) were compared to recently observed concentrations at monitoring wells, influent concentrations, and mass removal to assess the reliability of the 2009.25 plume shell and to identify potential areas for optimization.

6.1 Model Predictions versus Observed Concentrations

After system startup, the flow model was recalibrated to the observed hydraulic responses (ECC, 2010) and transport models were developed to evaluate model-predicted system performance from March 2009 (2009.25) and beyond. Plume shells used for analyses of perchlorate and RDX were constructed using data through March 2009. All transport parameters were identical to those described in the Draft J-2 Groundwater Remedial Investigation/Feasibility Study report (ECC 2007). For this annual report, the only changes to the J-2 Range Eastern model were to incorporate hydraulic stresses that have changed within the model domain, namely changes to injection/extraction rates at the FS-12 and J-1 Range Southern ETI systems. These changes were incorporated into the MODFLOW well files.

Data collected through March 2011 (model date 2011.25) were used to confirm the most recent depictions of perchlorate and RDX in plan and cross-sectional view. The observed conditions are presented in comparison to model-predicted conditions using the model and the 2009.25 plume shell using the model and migrating the 2009.25 plume shells to model data 2011.25. Stresses within the system were accounted for in the development of the MODFLOW well file. Comparisons of measured and predicted perchlorate and RDX concentrations are summarized in Tables 6-1 and 6-2.

The flow model represents “average” flow field conditions based on historic data and simulated during the development of the RI/FS for the J-2 Range. The only change to the flow model that is made from year-to-year is an update of the well file so that the pumping stress applied to the model is accurate. Therefore, it is expected that from one year to the next the flow model will either over or under predict measured conditions but in the long term the coupled flow and transport model will provide reliable predictions. Therefore, discrepancies between measured and predicted water levels are expected.

6.1.1 Perchlorate

The recently observed perchlorate plume is very similar to the model predicted (Figure 6-1) plume, having approximately the same length and width. The most upgradient portion of the perchlorate plume at the source area is predicted to have lower peak concentrations than the measured plume but these elevated concentrations in the measured plume are from forward migrated upgradient concentrations and have not been confirmed. The extent of the 2 µg/L perchlorate plume boundary at the source area is generally equivalent to the predicted plume in

this area. The central portion of the perchlorate plume is predicted to be approximately that of the measured plume including the extent of the 2 µg/L and the 15 µg/L perchlorate plume boundary. The downgradient portion of the perchlorate plume is predicted to be slightly smaller than the measured plume and does not show the downgradient migration of perchlorate concentrations above 15 µg/L northeast of extraction well J2EW0005 and towards MW-335. The smaller plumelets of perchlorate are largely represented by the model with the exception of the small plumes to the northwest of the main lobe of the plume and downgradient of extraction well J2EW0006. The plume located immediately southeast of the main lobe of the perchlorate plume is generally represented in extent and shape and the plume located further south of the main lobe, while depicted in the perchlorate predictions is smaller than the measured plume.

Influent perchlorate concentrations at the J-2 Range Eastern plume extraction wells are measured monthly at the treatment systems. Figure 6-3 presents the measured influent concentrations (prior to treatment) compared to model predicted influent concentrations for each extraction well. As indicated in Figure 6-3, at the beginning of the reporting period, predicted perchlorate concentrations at J2EW0004 are greater than measured concentrations by nearly 1 µg/L, with model predicted concentrations slightly less than 2 µg/L compared to measured concentrations of approximately 1.2 µg/L. Model predicted perchlorate concentrations decrease throughout the reporting period and by the end of the reporting period, closely match measured concentrations, which generally remained around approximately 1.2 µg/L throughout the reporting period.

At J2EW0005, where the well has two discrete well screens, measured influent concentrations were initially under by approximately 1 µg/L. Both the measured and model predicted perchlorate concentrations decreased at J2EW0005 during the reporting period. Measured concentrations decreased from approximately 4 µg/L at the start of the reporting period to approximately 2.5 µg/L at the end of the period. Similarly, predicted concentrations decreased from approximately 3 µg/L at the start of the reporting period to approximately 2.7 µg/L at the end of the period.

At J2EW0006, model predicted concentrations are consistently less than the measured concentrations throughout the reporting period. At the start of the period, measured concentrations are approximately 0.5 µg/L and predicted concentrations are approximately 0.25 µg/L and by the end of the reporting period the concentrations of each is only marginally less, with measured concentrations being approximately 0.45 µg/L and predicted concentrations being approximately 0.20 µg /L.

Figure 6-4 plots cumulative perchlorate mass removed since startup (measured vs. model predicted) for each extraction well. Extraction well J2EW0004 (MTU J) removed approximately 0.45 pounds of perchlorate from 1 August 2010 through 31 July 2011. This compares to a model predicted mass removal of 0.51 pounds for the same period. At extraction well J2EW0005 (MTUs H&I), the treatment plant removed 2.81 pounds of perchlorate between 1 August 2010 through 31 July 2011. This is in comparison to 2.45 pounds predicted by the model. At J2EW0006 (MTU K), the treatment plant removed 0.23 pounds of perchlorate between 1 August 2010 and 31 July 2011. This is in comparison to 0.12 pounds predicted by

the model. The total perchlorate measured to be removed by the treatment plants between 1 August 2010 and 31 July 2011 was 3.49 pounds and the total predicted to be removed was 3.07 pounds. In general, the model reliably predicted the mass removed at each of the three extraction wells J2EW0004 (MTU J), J2EW0005 (MTUs H&I) and J2EW0006 (MTU K).

6.1.2 RDX

The observed RDX plume is similar to the model predicted (Figure 6-2), however, the elevated RDX concentrations are higher than measured at the upgradient portion of the plume and lower than measured at the downgradient portion of the plume. Overall though, the width of the predicted and measured plumes is similar and the model using the plume shell from 2009.25 reliably captures the downgradient migration of RDX through the aquifer system.

Similar to perchlorate, the transport model indicates the predicted performance of the system, with respect to RDX, is similar to the system basis of design. Extraction wells J2EW0004, J2EW0005 and J2EW0006 effectively capture upgradient and cross-gradient portions of the plume.

Influent RDX concentrations at the J-2 Range Eastern plume extraction wells are measured monthly at the treatment systems. Figure 6-3 presents the measured influent concentrations (prior to treatment) compared to model predicted influent concentrations for each extraction well.

At J2EW0004, model predicted concentrations were less than or slightly above the measured concentrations throughout the reporting period. At the start of the period, measured concentrations are approximately 0.4 µg/L and predicted concentrations are approximately 0.3 µg/L and by the end of the reporting period the concentrations of each are approximately 0.25 µg/L.

At J2EW0005, where the well has two discrete well screens, measured influent concentrations were initially equivalent at approximately 0.8 µg/L. Both the measured and model predicted perchlorate concentrations decreased at J2EW0005 during the reporting period. Measured concentrations decreased from approximately 0.8 µg/L at the start of the reporting period to approximately 0.5 µg/L at the end of the period. Similarly, predicted concentrations decreased slightly from approximately 0.8 µg/L at the start of the reporting period to approximately 0.75 µg/L at the end of the period.

At J2EW0006, model predicted concentrations are consistently much less than the measured concentrations throughout the reporting period. At the start of the period, measured concentrations are approximately 0.8 µg/L and predicted concentrations are approximately 0.2 µg/L and by the end of the reporting period the measured concentrations are approximately 0.6 µg/L and the predicted concentrations are only marginally less than at the start.

Figure 6-4 plots cumulative RDX mass removed since startup (measured vs. model predicted) for each extraction well. Extraction well J2EW0004 (MTU J) removed approximately 0.11 pounds of RDX from 1 August 2010 through 31 July 2011. This compares to a model predicted

mass removal of 0.12 pounds for the same period. At extraction well J2EW0005 (MTUs H&I), the treatment plant removed 0.56 pounds of RDX between 1 August 2010 through 31 July 2011. This is in comparison to 0.68 pounds predicted by the model. At J2EW0006 (MTU K), the treatment plant removed 0.37 pounds of RDX between 1 August 2010 and 31 July 2011. This is in comparison to 0.09 pounds predicted by the model. The total RDX measured to be removed by the treatment plants between 1 August 2010 and 31 July 2011 was 1.04 pounds and the total predicted to be removed was 0.88 pounds. In general, the model reliably predicted the mass removed at each of the three extraction wells J2EW0004, J2EW0005 and J2EW0006.

6.2 J-2 Range Eastern Plume ETI System Capture Zone

The results of the transport evaluation indicated that the system is meeting the basis of design. Particle tracking in the model was used to develop the predicted system capture zone under current operating conditions (Figure 6-5). The model-predicted capture zone is wider than the outline of the J-2 Range Eastern plume, particularly to the west of the main perchlorate/RDX plume in proximity to MW-388, where concentrations of perchlorate and RDX are below 2 µg/L and 0.6 µg/L, respectively. If optimization is considered, a reverse particle track figure will be submitted to support the assertion that capture will be provided by the extraction wells under the modified pumping scenario. Presently, the majority of the perchlorate and RDX contamination is within the model-predicted capture zone with some small areas of low perchlorate and RDX concentrations outside the capture zone. For example, the perchlorate concentrations in the western detached lobe are predicted to be diminished to less than 2 µg/L in 2011 and in the eastern detached lobe are predicted to be diminished to less than 2 µg/L in 2015. Discrepancies between observed and predicted water levels indicate that the capture zone predicted by the model on a year over year basis may not provide a reliable demonstration of capture under current conditions but over the long term the capture zone predicted by the model is believed to adequately represent capture using the current extraction system. Additional evaluation of the J-2 Range Eastern capture zone will be presented in the RI/FS currently being developed for the J-2 Range.

The perchlorate concentrations in the western detached lobe are predicted to be diminished to less than 2 µg/L in 2011 and in the eastern detached lobe are predicted to be diminished to less than 2 µg/L in 2015. The potential for migration of the plumelets east and west of the main J-2 Eastern plume will be further investigation in the RI/FS for the J-2 Range.

Discrepancies between observed and predicted water levels indicate that the capture zone predicted by the model on a year over year basis may not provide a reliable demonstration of capture under current conditions but over the long term the capture zone predicted by the model is believed to adequately represent capture using the current extraction system. An additional evaluation will be provided in the RI/FS for the J-2 Range.

6.3 Discussion

The 2009.25 plume shell continues to be a better predictive tool for J-2 Range Eastern plume transport than previous model variants. The model-predicted hydraulic response to system start-up at J-2 Range Eastern plume is good when compared to observed data at most locations.

In several instances, the model under-predicts the hydraulic response, suggesting model-predictions of system performance may be conservative. The observed hydraulic stress in the aquifer imposed by system operation is greater than predicted by the model. Therefore, hydraulic gradients to the wells are steeper than predicted and plume capture is also likely under-predicted. The delayed drawdown response observed in the evaluation of the six-month synoptic data indicates the model is also under-predicting the long-term hydraulic response of the ETI system.

Remediation timeframes therefore may be somewhat shorter than model-predicted due to better-than-predicted performance. The model-predicted gradient across the site is very similar to the observed gradient and the predicted flow field under average water level conditions is a good match to observed long-term plume trajectories.

The results of the capture zone and transport evaluations indicate the system is meeting the basis of design and may be over-pumping at one or more wells.

7.0 RECOMMENDATIONS

Recommendations for modification to the J-2 Range Eastern plume ETI system operations and monitoring are presented in this section.

7.1 Plant Operation and Sampling

During the reporting period, the J-2 Range Eastern plume ETI system has operated as designed. During this reporting period, there was no breakthrough of perchlorate through the IX vessels. Individual MTUs did experience infrequent breakthrough of explosive compounds from the first GAC vessel in the treatment train. These breakthroughs were detected during monthly monitoring and GAC change-out quickly performed. This process resulted in no effluent discharges of the COCs. Thus, the J-2 Range Eastern plume ETI system is treating groundwater as designed. As a result, no changes are recommended to the current system operating and monitoring procedures.

7.2 Wellfield Recommendations

There are no recommendations for modifying wellfield flow rates at this time. As additional monitoring well and influent data is collected it will be evaluated, and recommendations may be made in future annual reports.

7.3 Hydraulic Monitoring

There are no recommendations for modifying hydraulic monitoring locations within the J-2 Eastern area other than to reiterate those made in the Final J-2 Range Eastern Interim Environmental Monitoring Report March 2009 through July 2010 (USACE 2011).

7.4 Chemical Monitoring

Several wells (MW-355M1 and MW-362M1) that are currently included within the J-2 Eastern monitoring plan are located more than 2,000 feet east of the centerline of the main lobes of both the perchlorate and RDX plumes and plumelets. Additionally, these wells have consistently, with few exceptions, had perchlorate and RDX concentrations that have been ND or significantly less than their respective regulatory thresholds. The continued chemical monitoring of these wells does not provide any additional useful information regarding the perchlorate and RDX plumes and it is recommended that these wells be removed from the J-2 Eastern monitoring program.

The following wells are proposed for removal from the chemical monitoring program:

- MW-355M1 – Located 2,000 feet southeast of the small perchlorate plumelet that is immediately downgradient of well MW-342M1. Perchlorate has been measured six times since 2004 and reported as non-detect for the five samples collected from 2004 to 2009

and 0.102 µg/L for the sample collected most recently in 2010. RDX is currently not being sampled for at this well.

- MW-362M1 – Located 2,800 feet southeast of the small perchlorate plumelet that is hydraulically downgradient of well MW-342M1. Perchlorate has been measured four times since 2005 and reported as non-detect for the three samples collected in 2005 and 0.0191 µg/L for the sample collected most recently in 2010. RDX is currently not being sampled at this well.

7.5 Modeling

The relatively poor comparison between measured and predicted perchlorate and RDX concentrations suggest that the perchlorate and RDX plume shells should be updated to improve the reliability of the model and its ability to accurately predict the spatial and temporal distribution of contaminant concentrations. Additionally, the reliability of the flow model should be re-evaluated during the development of the RI/FS for the J-2 Range.

8.0 REFERENCES

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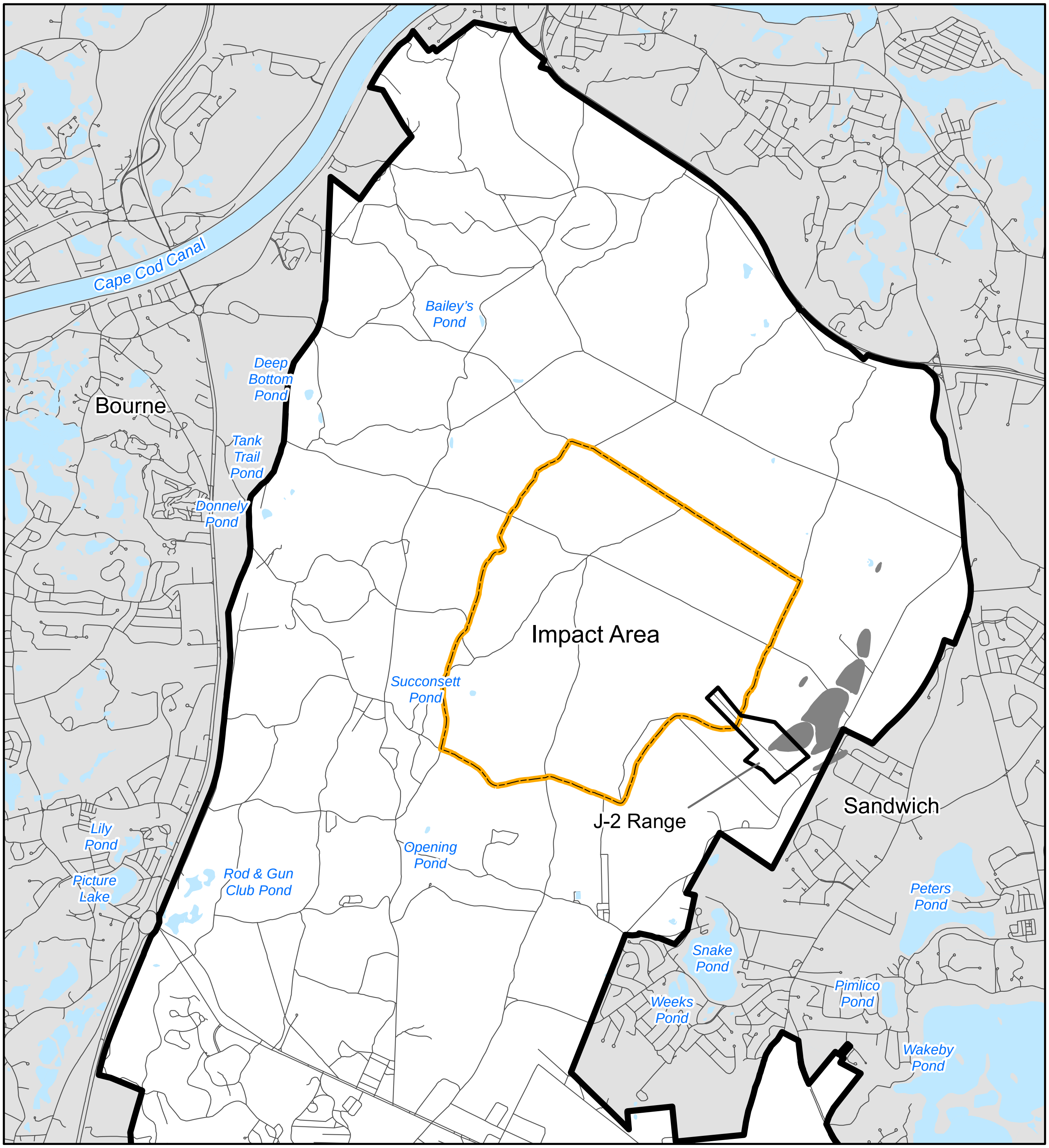
FIGURES

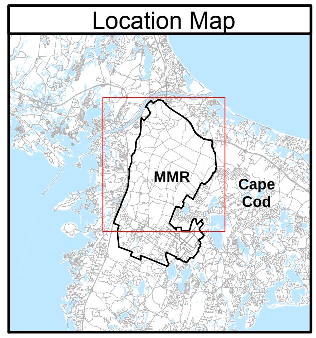


Legend

MMR Boundary

Impact Area Boundary

J-2 Range Eastern Composite Perchlorate (shown to 2 μg/L) and RDX (shown to (0.6 μg/L)



0 2,500 5,000 Feet

US Army Corps of Engineers New England District

Location of J-2 Range

FIGURE 1-1

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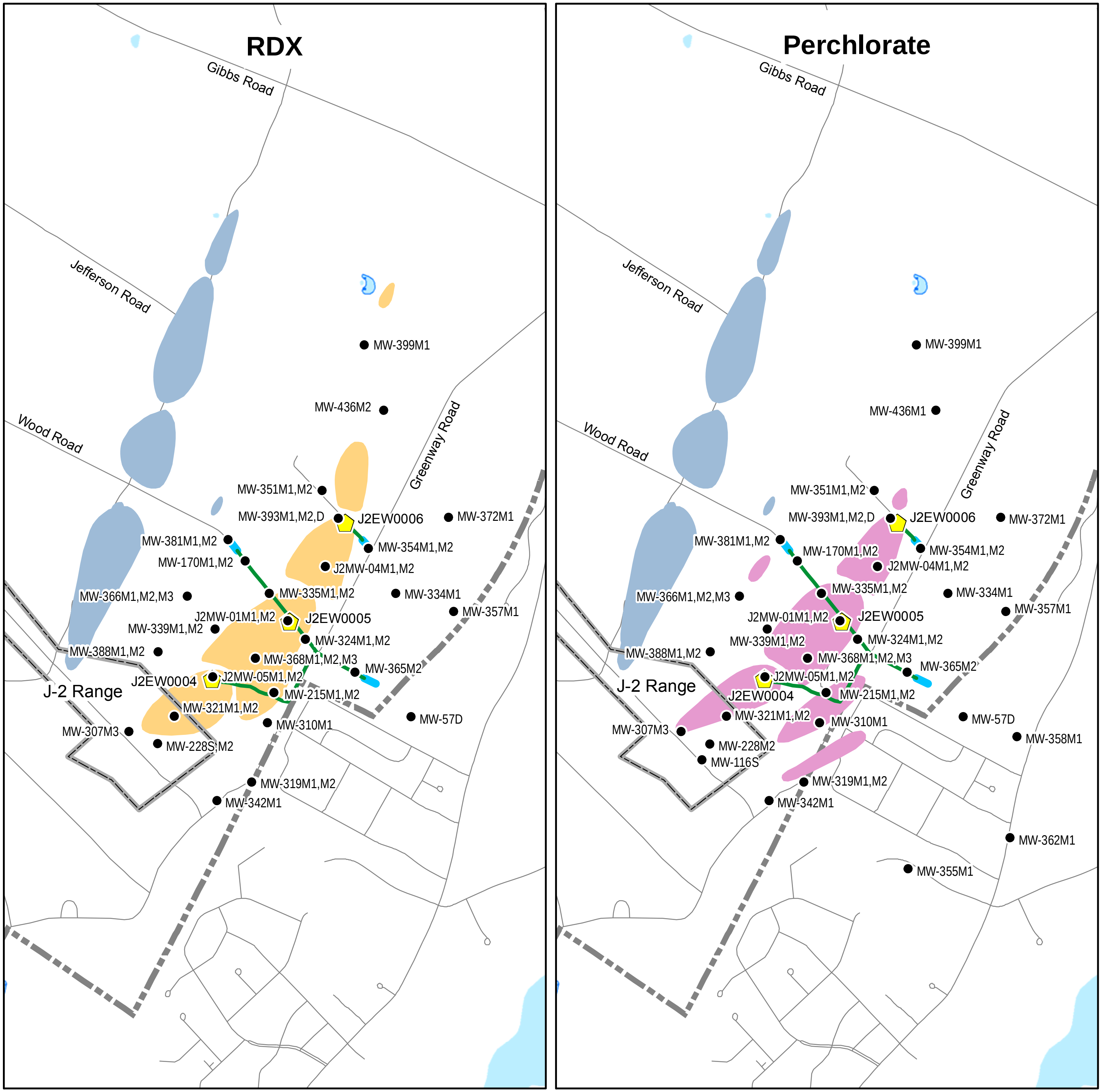
July 31, 2012 DWN: MTW CHKD: KJH

Impact Area Groundwater Study Program

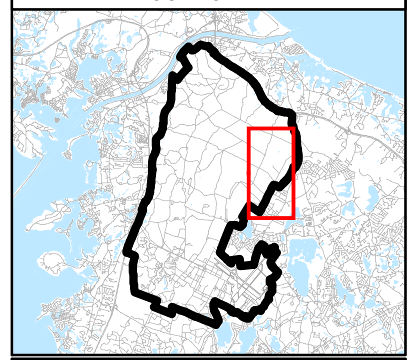


Impact Area
Groundwater Study Program

LEGEND

- Monitoring Well
- Extraction Well
- Infiltration Trench
- Effluent Piping
- J-2 Range Boundary
- MMR Boundary
- Perchlorate Plume (shown to 2 μg/L)
- RDX Plume (shown to 0.6 μg/L)
- J-2 Range Northern Composite Perchlorate (shown to 2 μg/L) and RDX (Shown to 0.6 μg/L) Plume

LOCATION MAP



NOTES & SOURCES

Map Coordinate System: NAD83 UTM Zone 19N Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Maps: Source: MassGIS

TITLE

J-2 Range Eastern
Chemical Monitoring Network

0 2,000
Feet

N

US Army Corps
of Engineers
New England District

FIGURE
1-2

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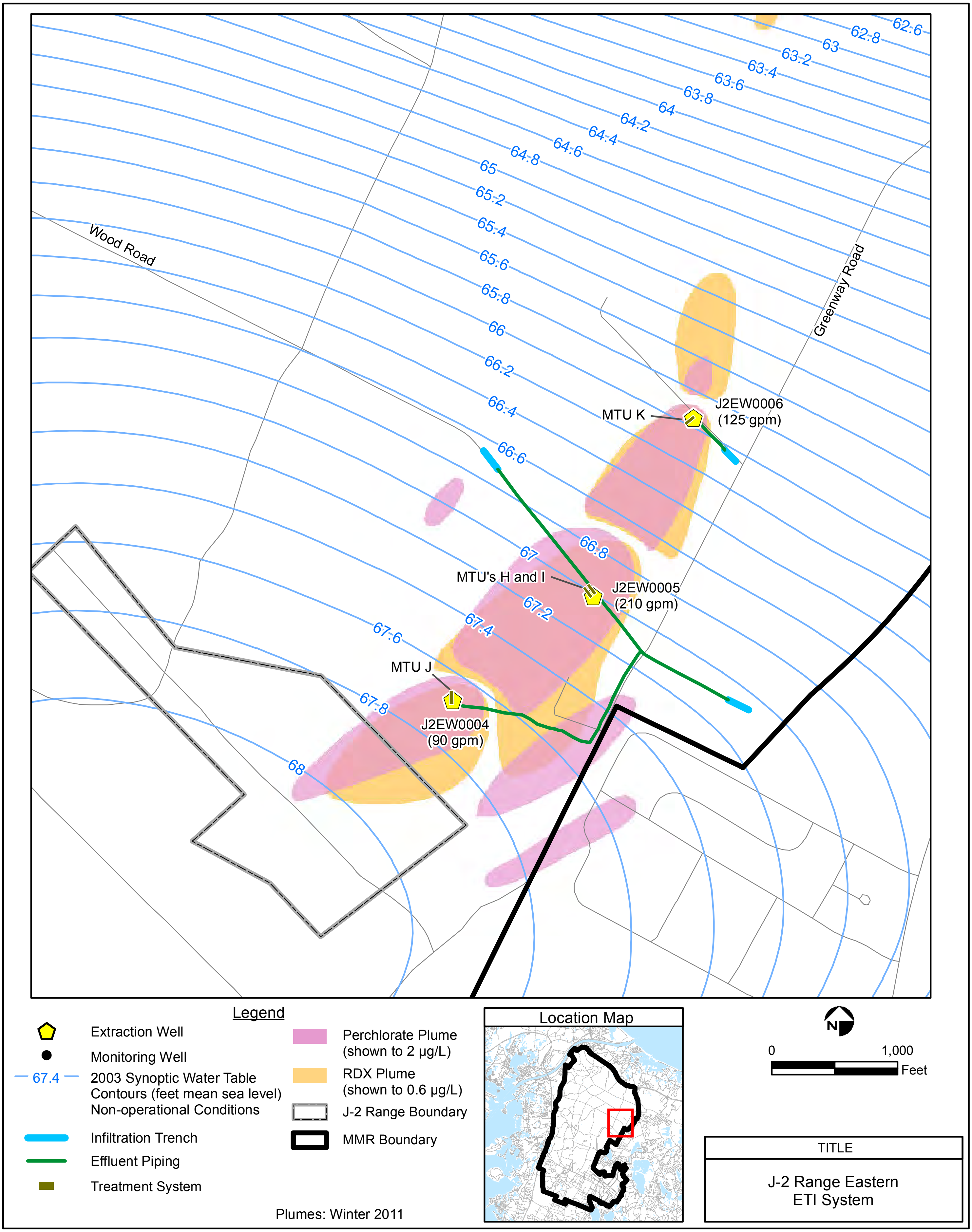
November 17, 2011 DWN: MTW CHKD: KJH



TITLE

J-2 Range Eastern ETI System

US Army Corps of Engineers
New England District

Impact Area Groundwater Study Program

FIGURE 2-1

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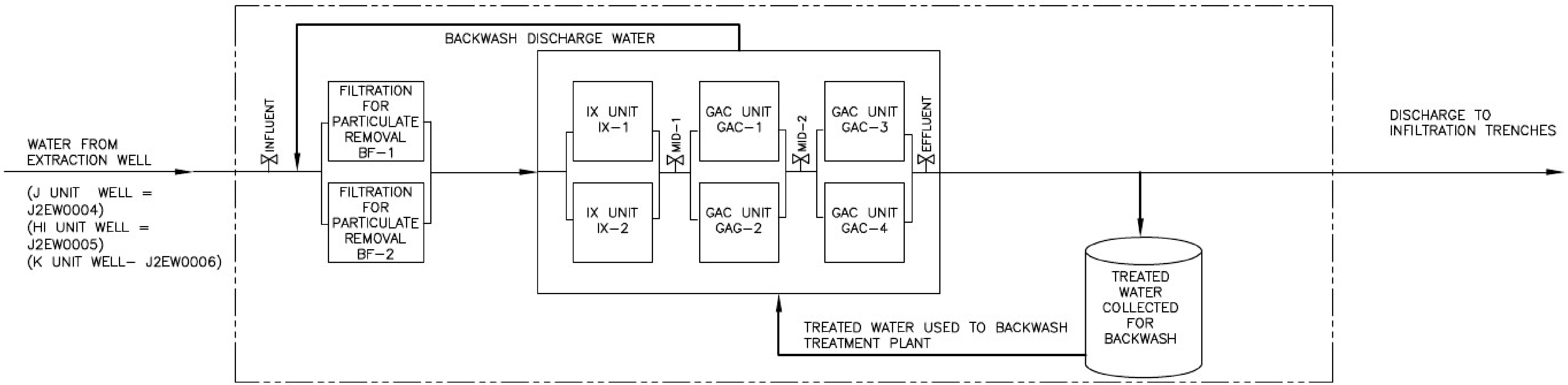
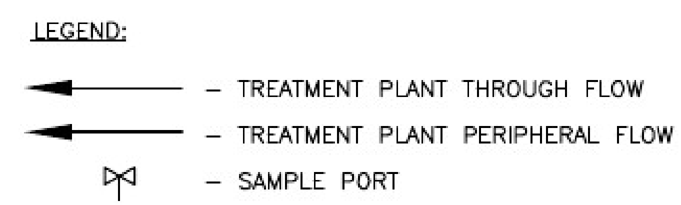


Systems for Modular
Units J, K and HI

SAMPLING LOCATIONS

INFLUENT	INFLUENT SAMPLE LOCATIONS	PERCHLORATE AND EXPLOSIVES
MID-1	PRIMARY MIDFLUENT LOCATIONS	PERCHLORATE
MID-2	SECONDARY MIDFLUENT SAMPLE LOCATIONS	EXPLOSIVES
EFFLUENT	EFFLUENT SAMPLE LOCATIONS	PERCHLORATE AND EXPLOSIVES



J-2 Range Eastern
Modular Treatment Unit for Systems J, K and HI
Process Flow Diagram

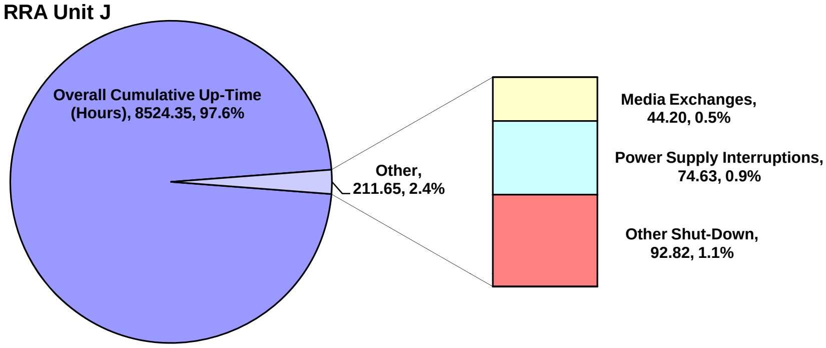
DATE: 11/01/10

2-2

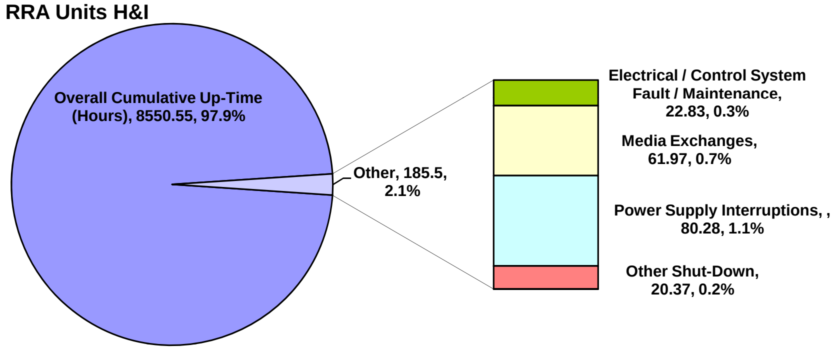
Xref TITLE–J2E–B.dwg

Figure 2-3
Downtime by Category
J-2 Range Eastern GW RRA Systems
August 2010 through July 2011

a) J-2 Range Eastern GW RRA Unit J



b) J-2 Range Eastern GW RRA Units H&I



c) J-2 Range Eastern GW RRA Unit K

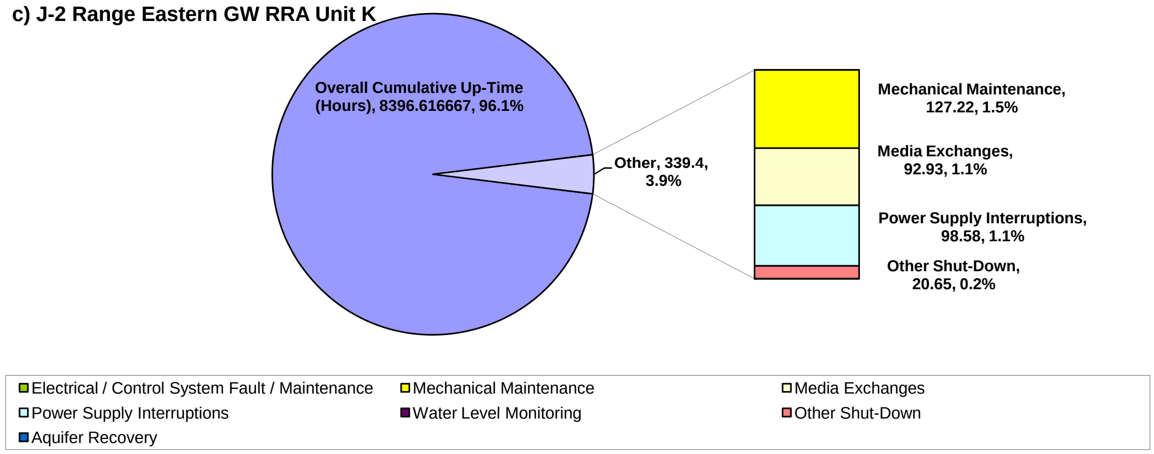


Figure 3-1
Influent Contaminant Concentration
J-2 Range Eastern GW RRA Unit J

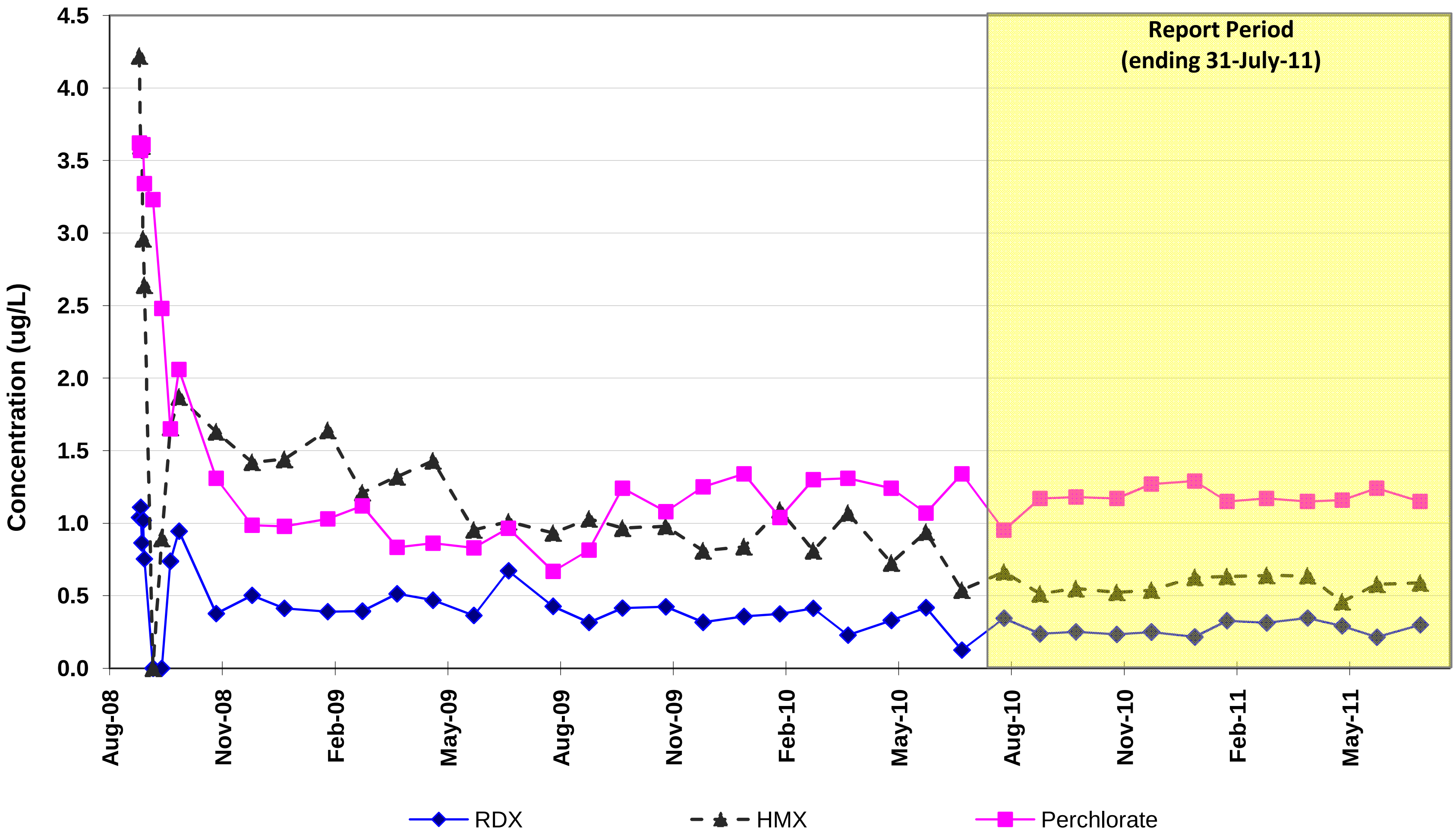


Figure 3-2
Total Groundwater Volume Treated Since Startup
J-2 Range Eastern GW RRA Unit J

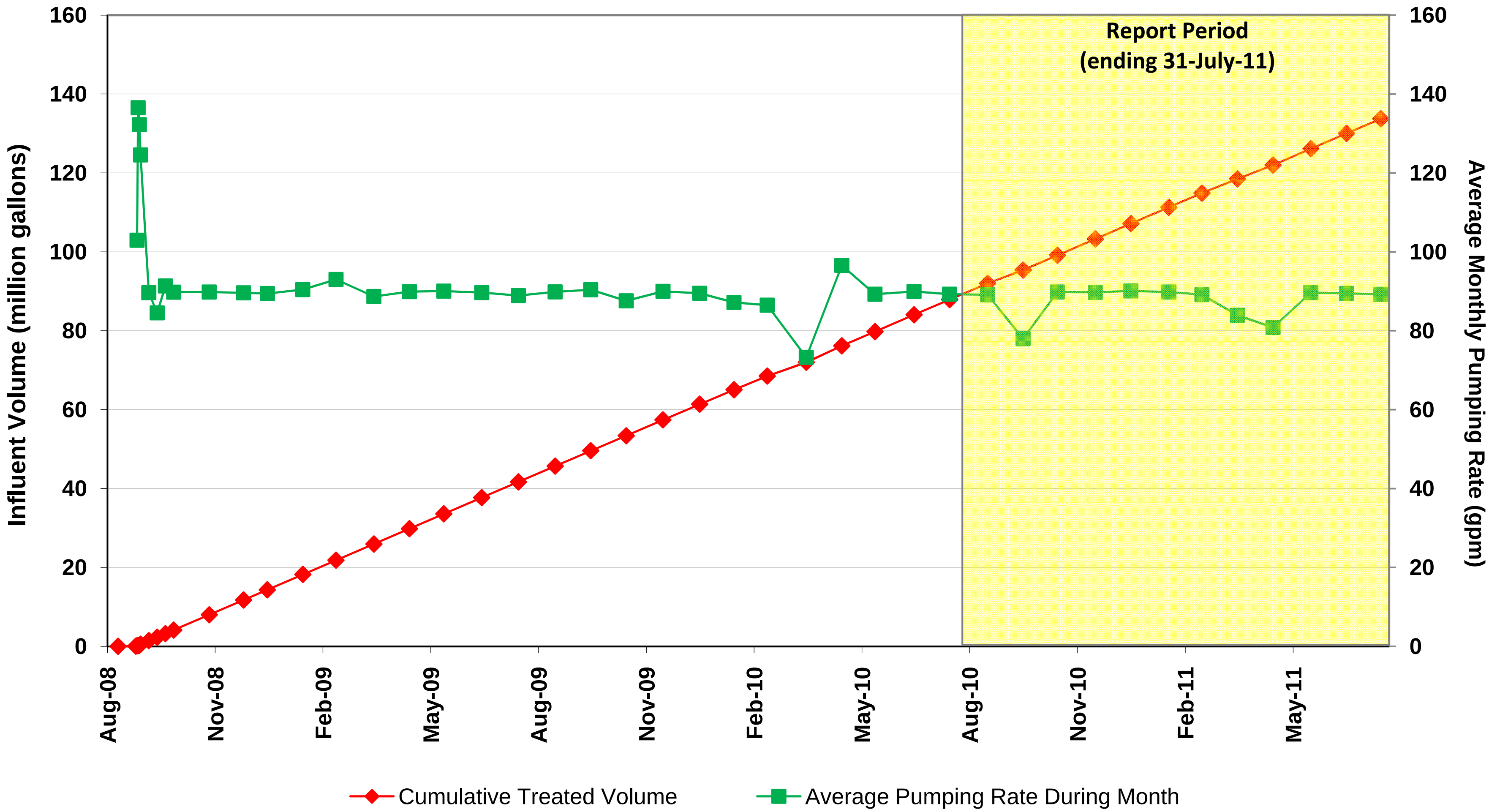


Figure 3-3
Contaminant Mass Removal
J-2 Range Eastern GW RRA Unit J

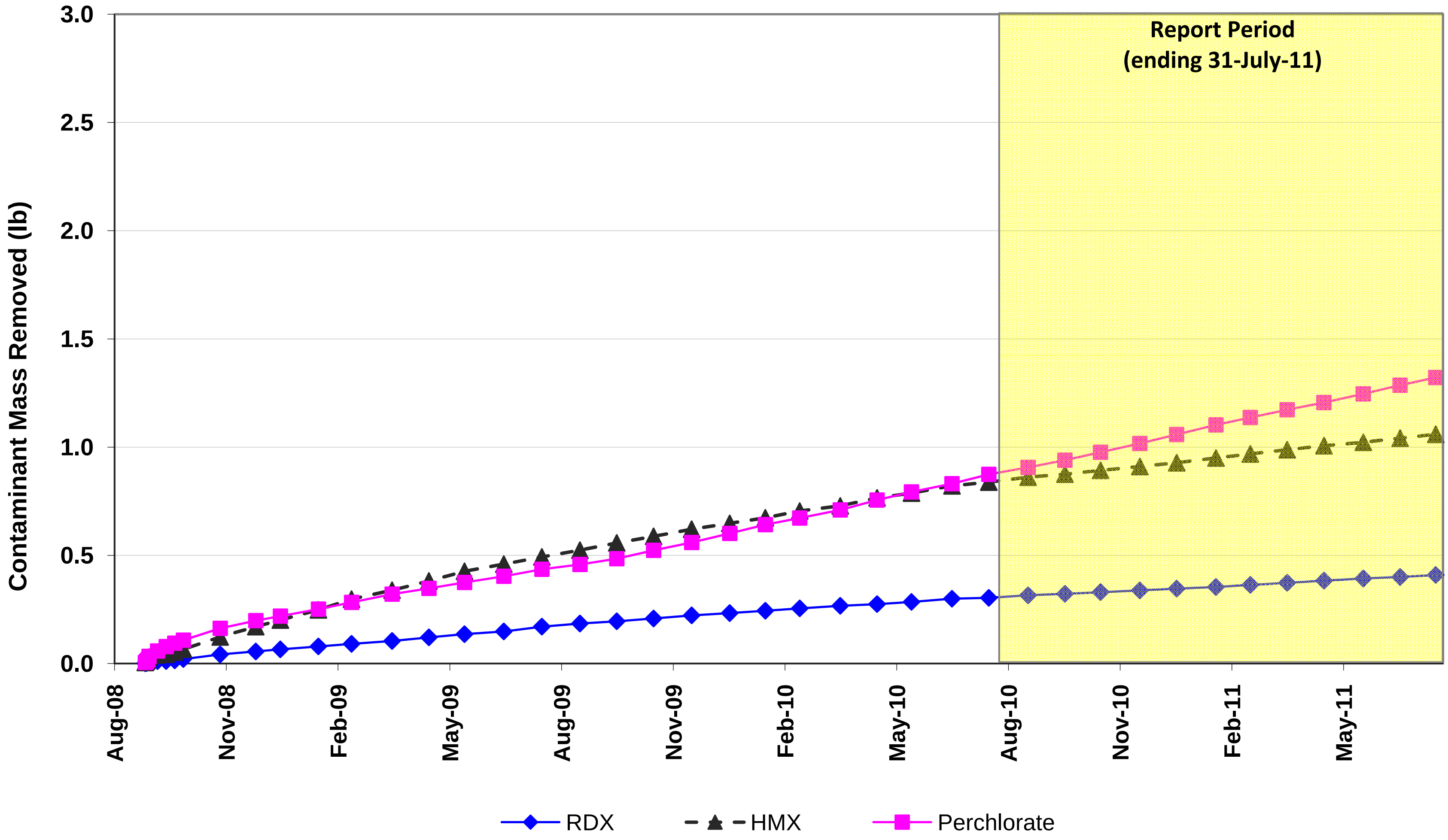


Figure 3-4
Influent Contaminant Concentration
J-2 Range Eastern GW RRA Units H&I

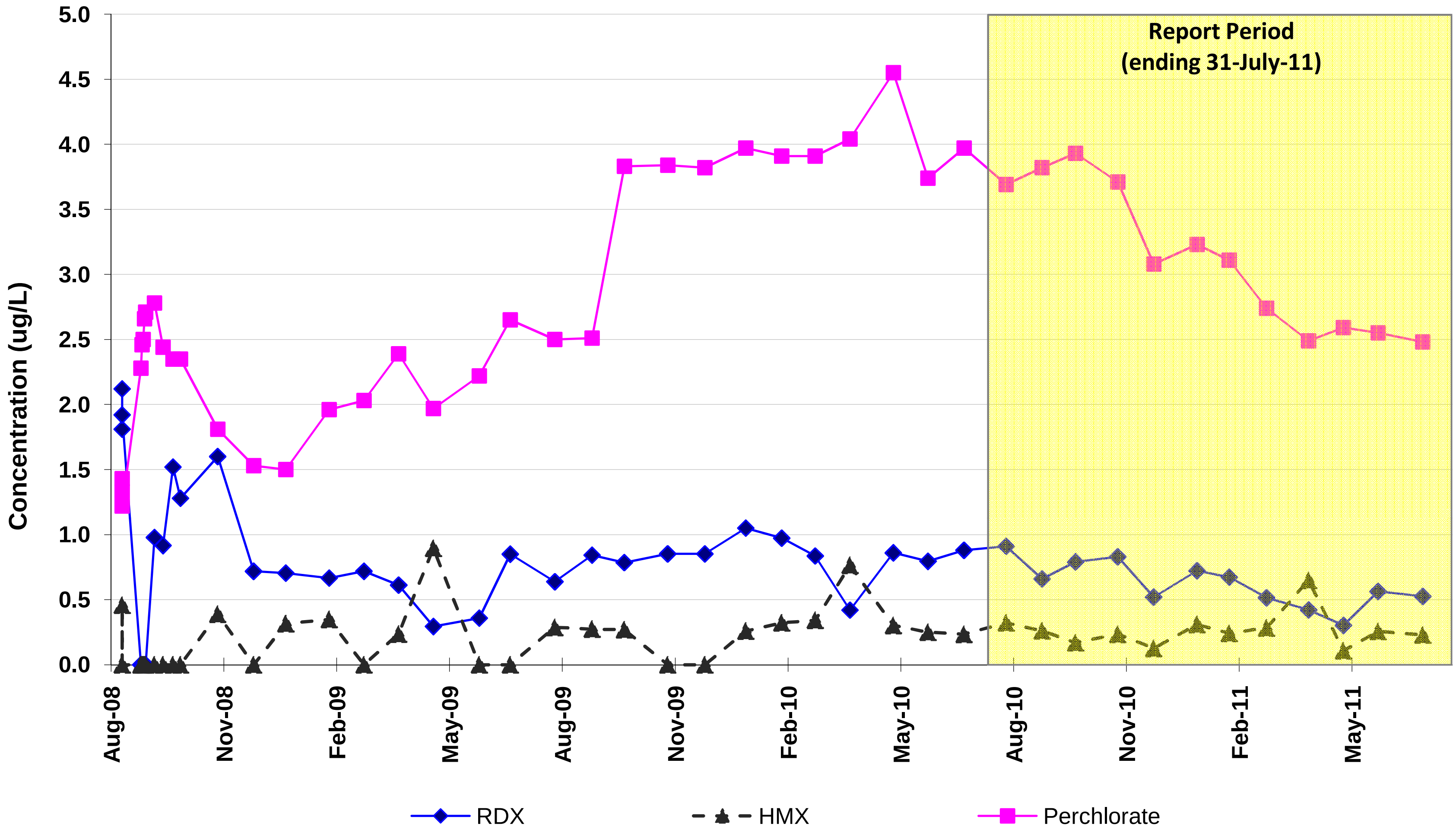


Figure 3-5
Total Groundwater Volume Treated Since Startup
J-2 Range Eastern GW RRA Units H&I

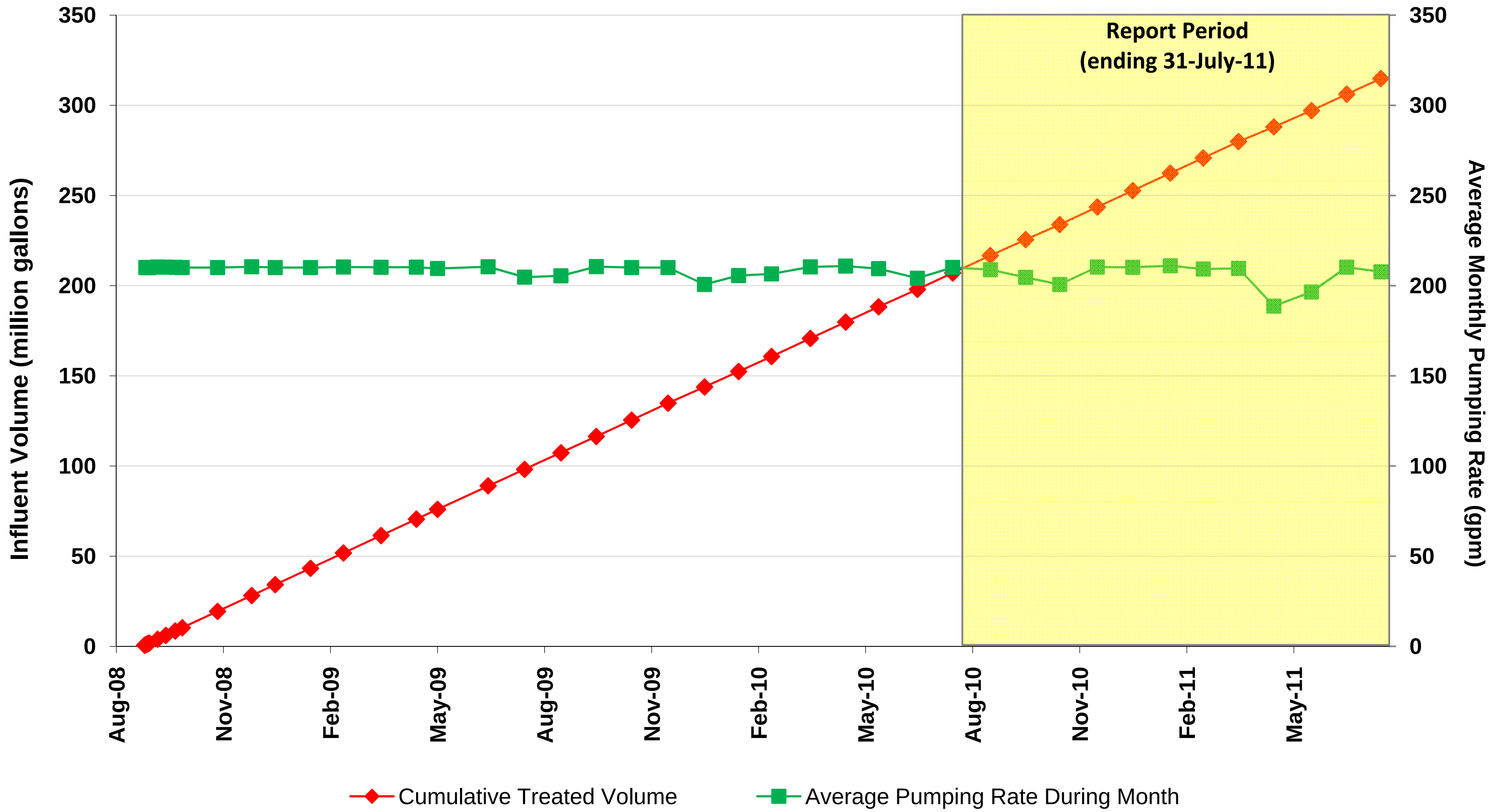


Figure 3-6
Contaminant Mass Removal
J-2 Range Eastern GW RRA Units H&I

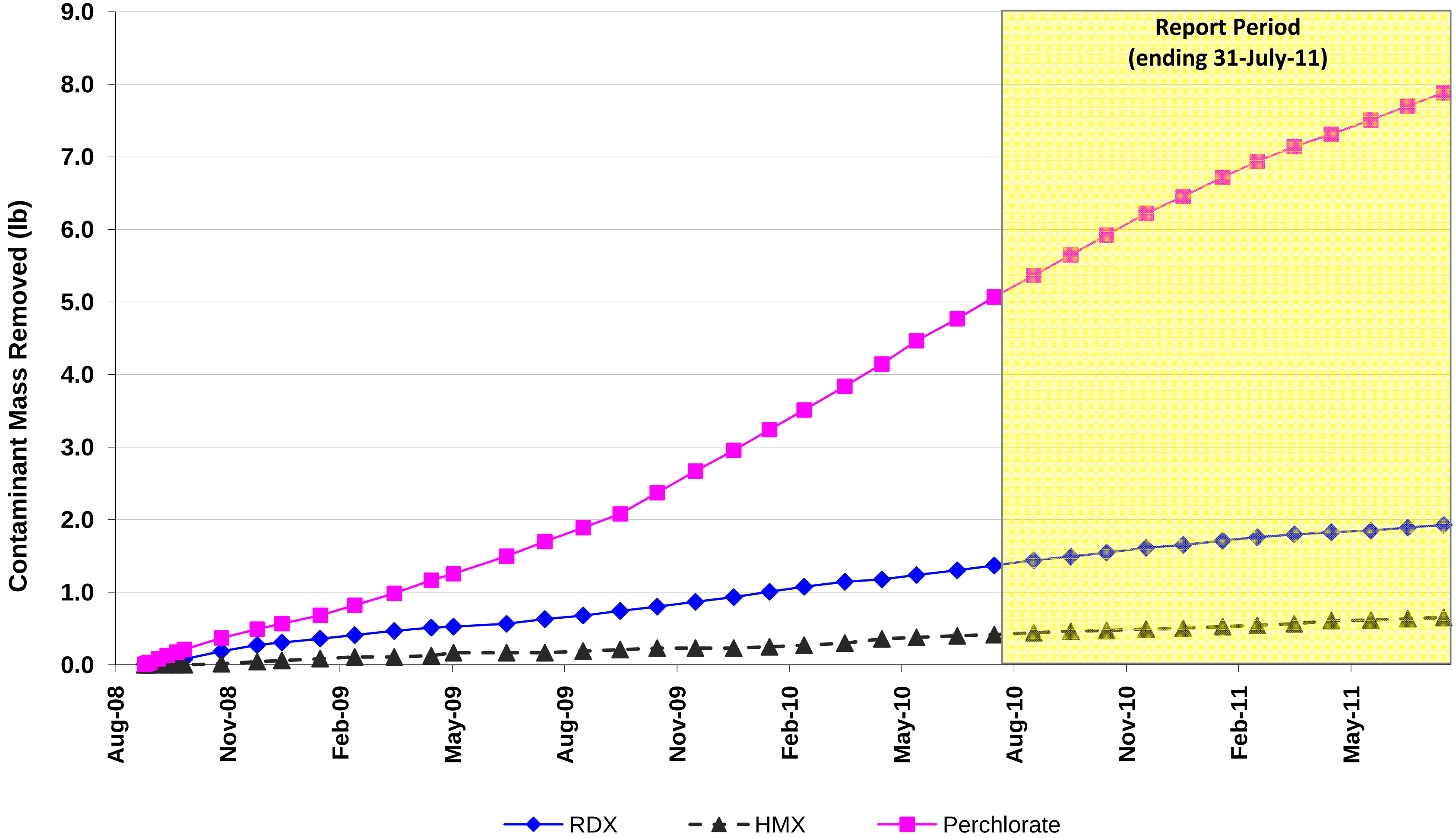


Figure 3-7
Influent Contaminant Concentration
J-2 Range Eastern GW RRA Unit K

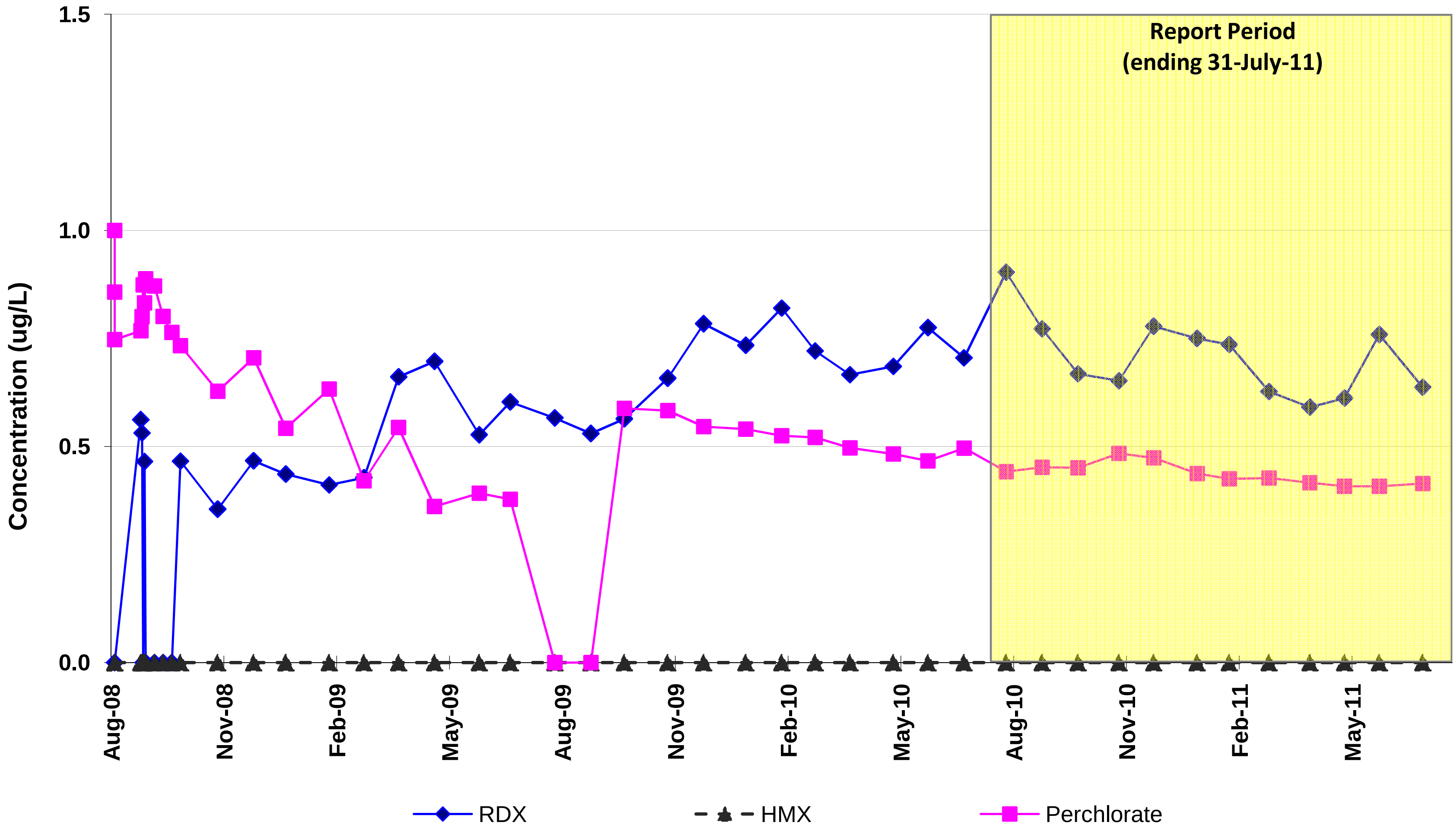


Figure 3-8
Total Groundwater Volume Treated Since Startup
J-2 Range Eastern GW RRA Unit K

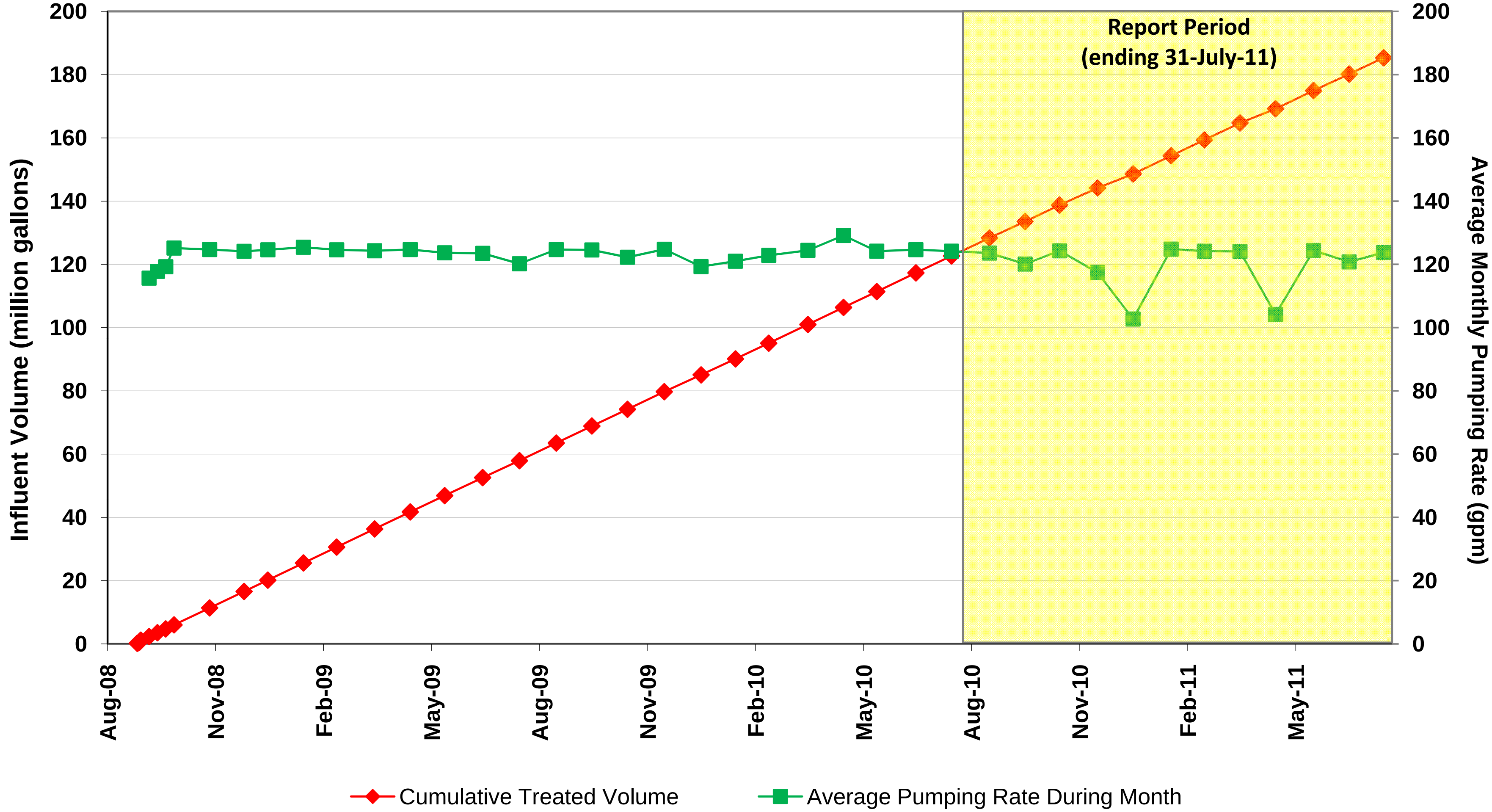
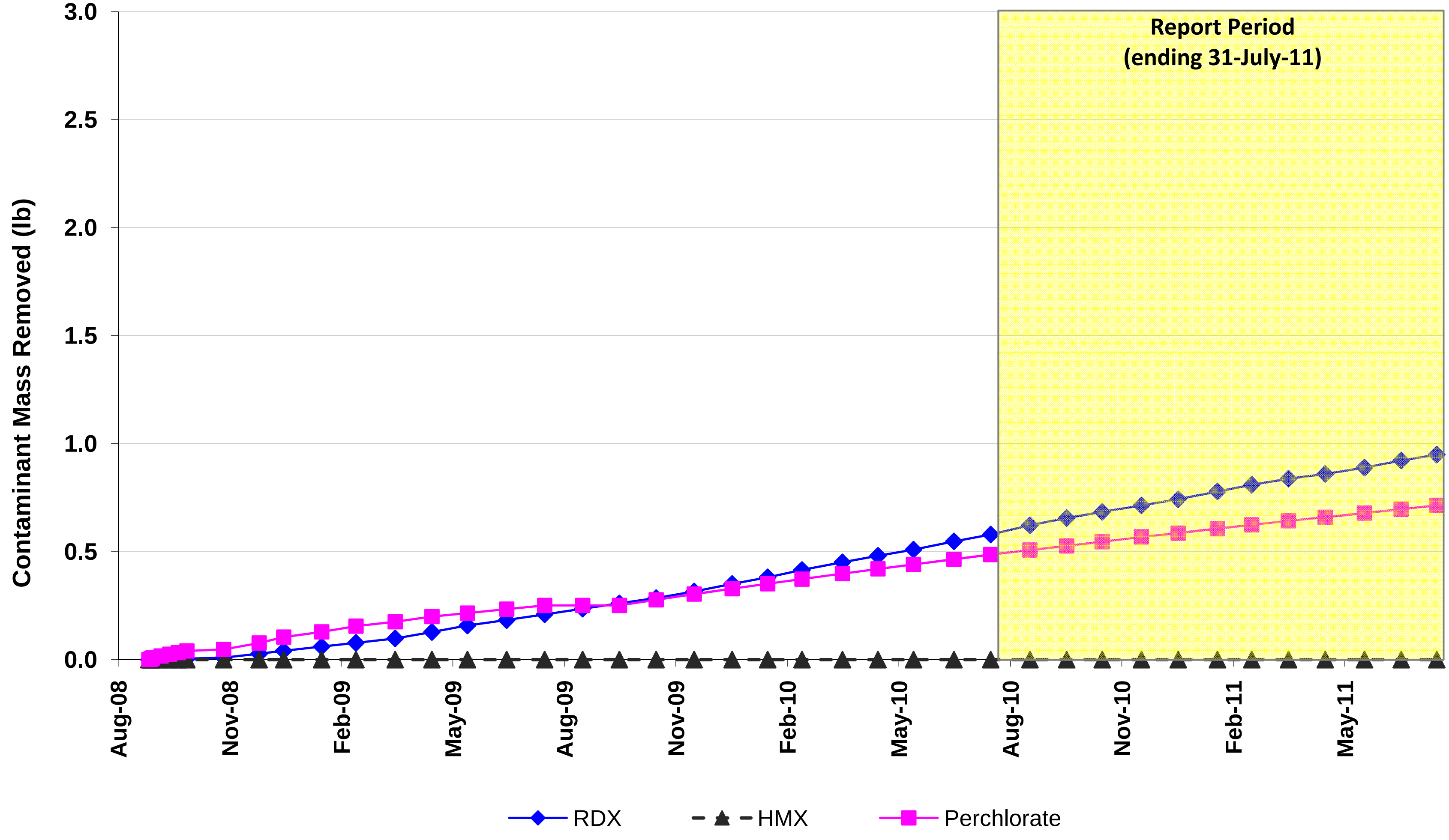
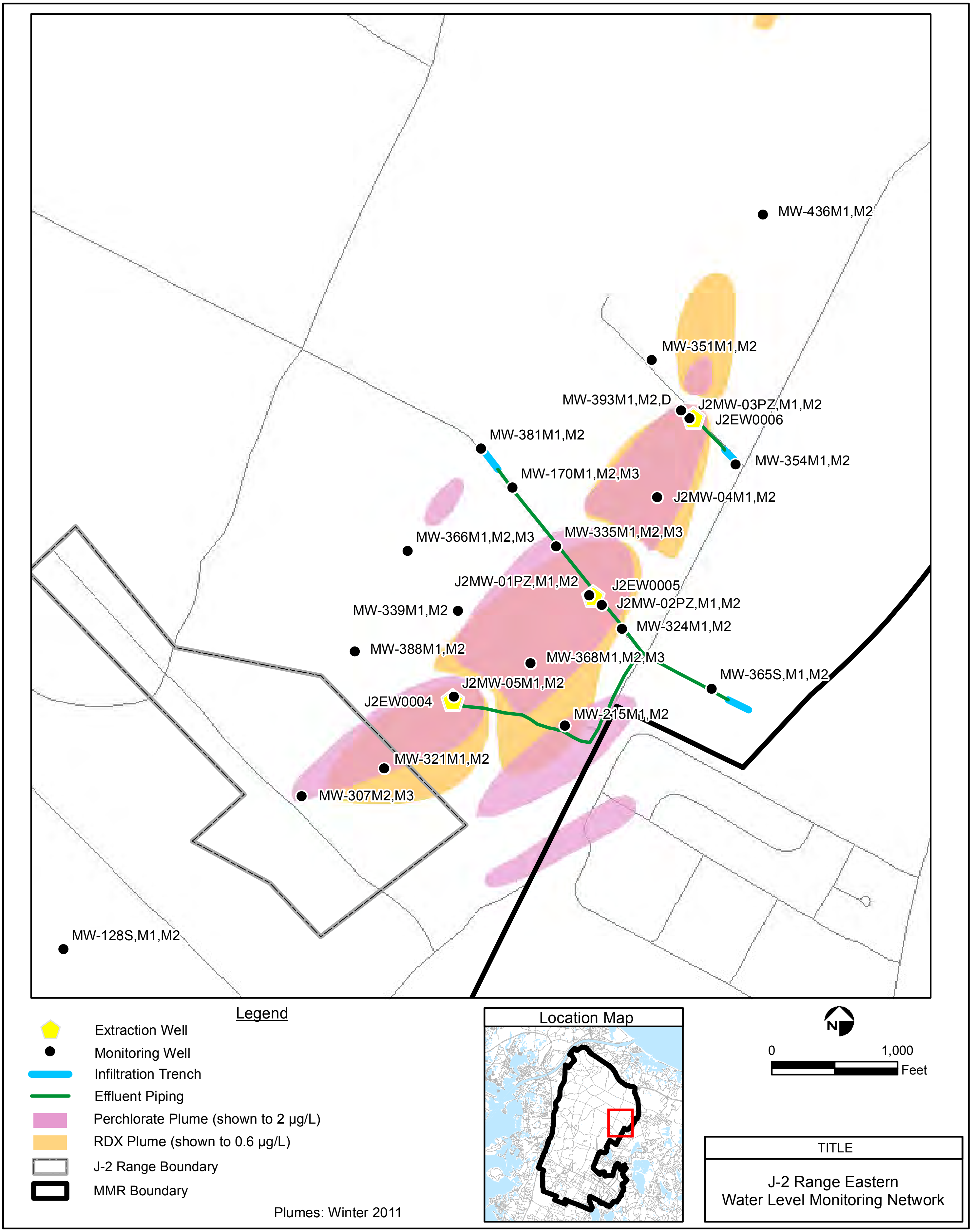


Figure 3-9
Contaminant Mass Removal
J-2 Range Eastern GW RRA Unit K





TITLE

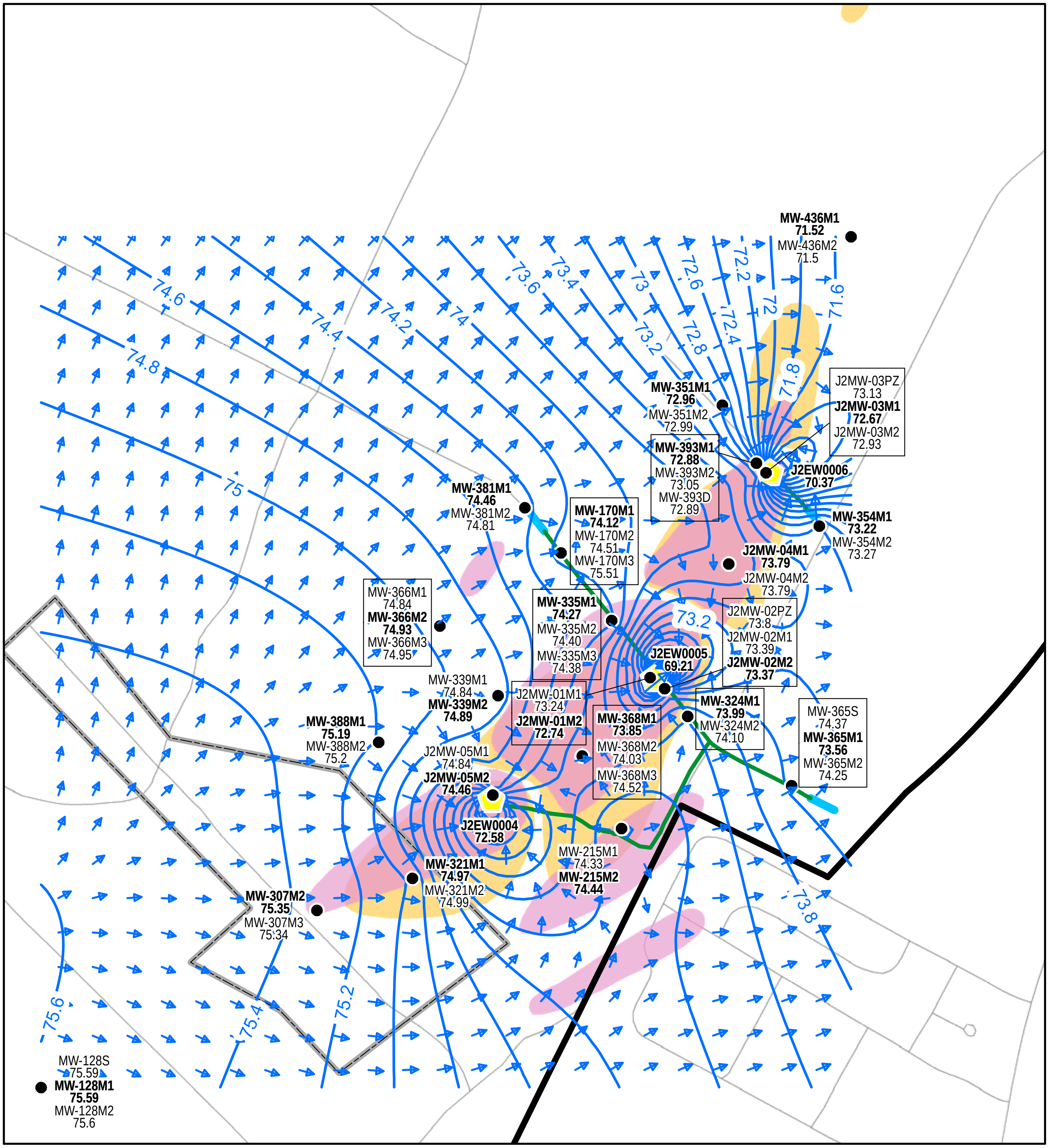
J-2 Range Eastern
Water Level Monitoring Network

US Army Corps of Engineers
New England District

Impact Area
Groundwater Study Program

FIGURE
4-1

M:\MMR\2011\J-2East\AnnRpt\Figures\Fig4-1_111711.pdf
M:\MMR\2011\J-2East\AnnRpt\MXDs\Fig4-1_111711.mxd
November 17, 2011 DWN: MTW CHKD: KJH

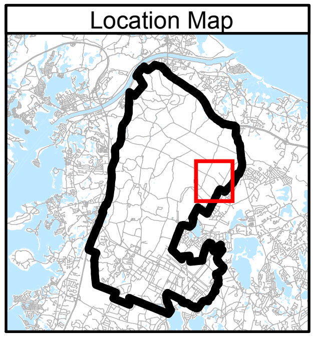


Legend

- Extraction Well
- Monitoring Well
- 74.2 Potentiometric Contours, 0.2 foot mean sea level intervals
- Infiltration Trench
- Effluent Piping
- Perchlorate Plume (shown to 2 µg/L)
- RDX Plume (shown to 0.6 µg/L)
- J-2 Range Boundary
- MMR Boundary

Perchlorate Plume: Winter 2011
RDX Plume: Fall 2010

Location Map



N

0 1,000
Feet

TITLE

J-2 Range Eastern Groundwater Potentiometric Map for 13 September 2010

US Army Corps of Engineers
New England District

Impact Area
Groundwater Study Program

FIGURE
4-2

M:\MMR\2011\J-2East\AnnRpt\Figures\Fig4-2_052912.pdf
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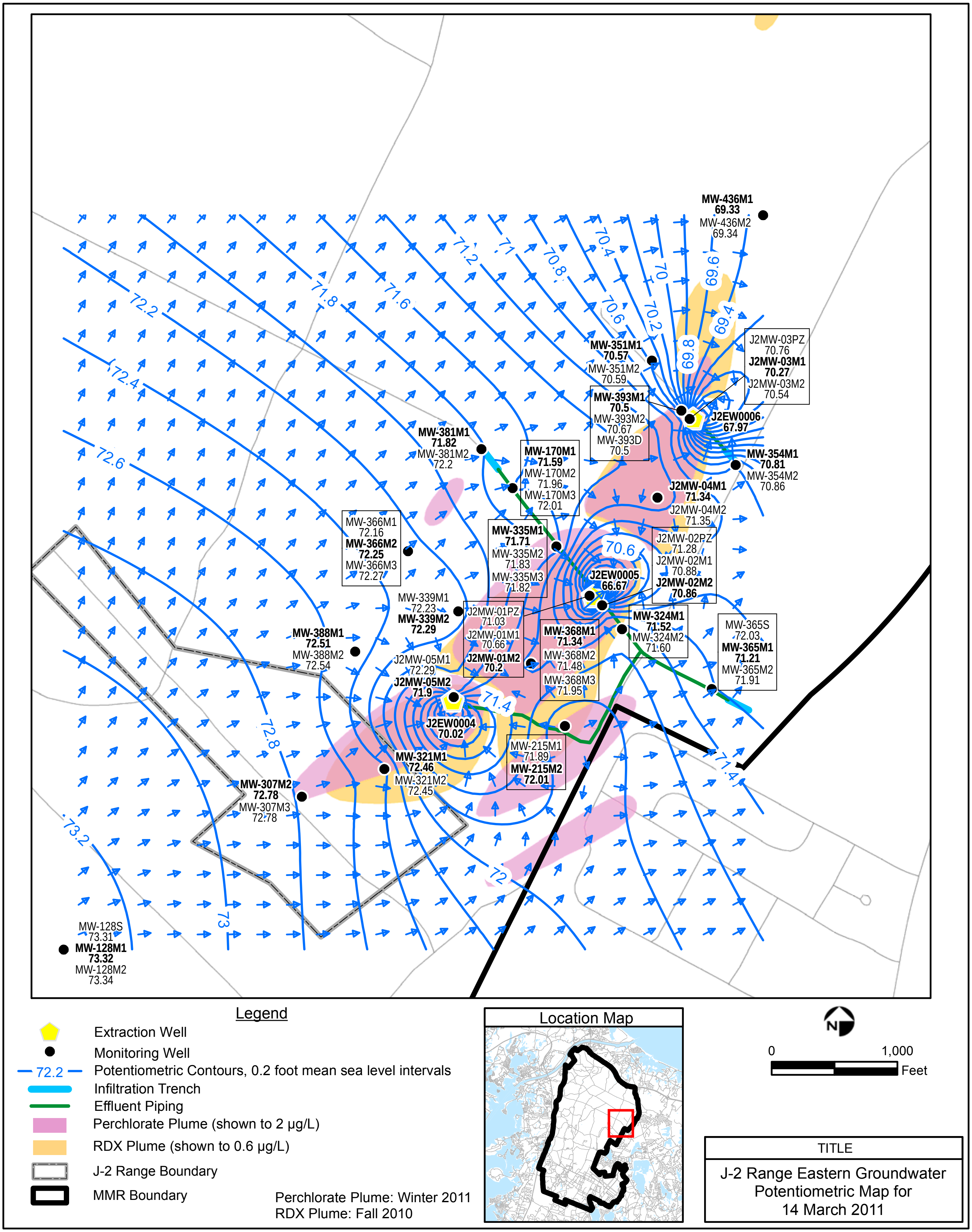
May 29, 2012 DWN: MTW CHKD: KJH



TITLE

J-2 Range Eastern Groundwater Potentiometric Map for 14 March 2011

US Army Corps of Engineers
New England District

Impact Area
Groundwater Study Program

FIGURE 4-3

M:\MMR\2011\J-2East\AnnRpt\Figures\Fig4-3_052912.pdf
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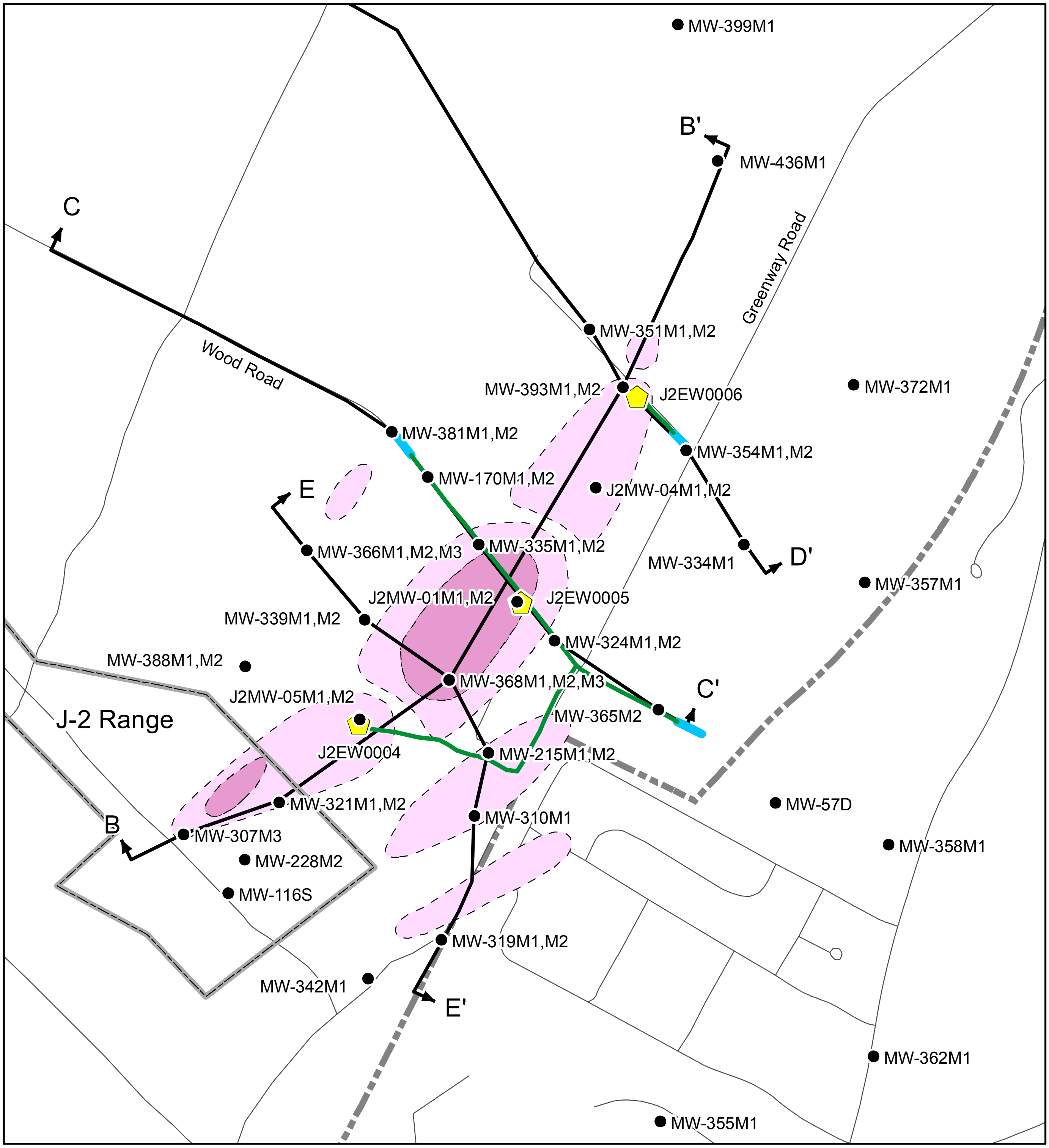
May 29, 2012 DWN: MTW CHKD: KJH



Legend

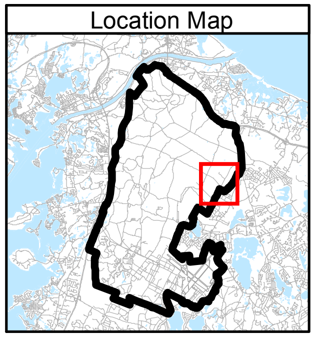
- Monitoring Well
- Extraction Well
- Infiltration Trench
- Effluent Piping

Perchlorate Detections

- 2-15 µg/L
- 15-200 µg/L
- J-2 Range Boundary
- MMR Boundary

Plume: Winter 2011

Location Map



N

0 1,000 Feet

TITLE

J-2 Range Eastern Plume Perchlorate Distribution and Lines of Cross Section Location

US Army Corps of Engineers New England District

Impact Area Groundwater Study Program

FIGURE 5-1

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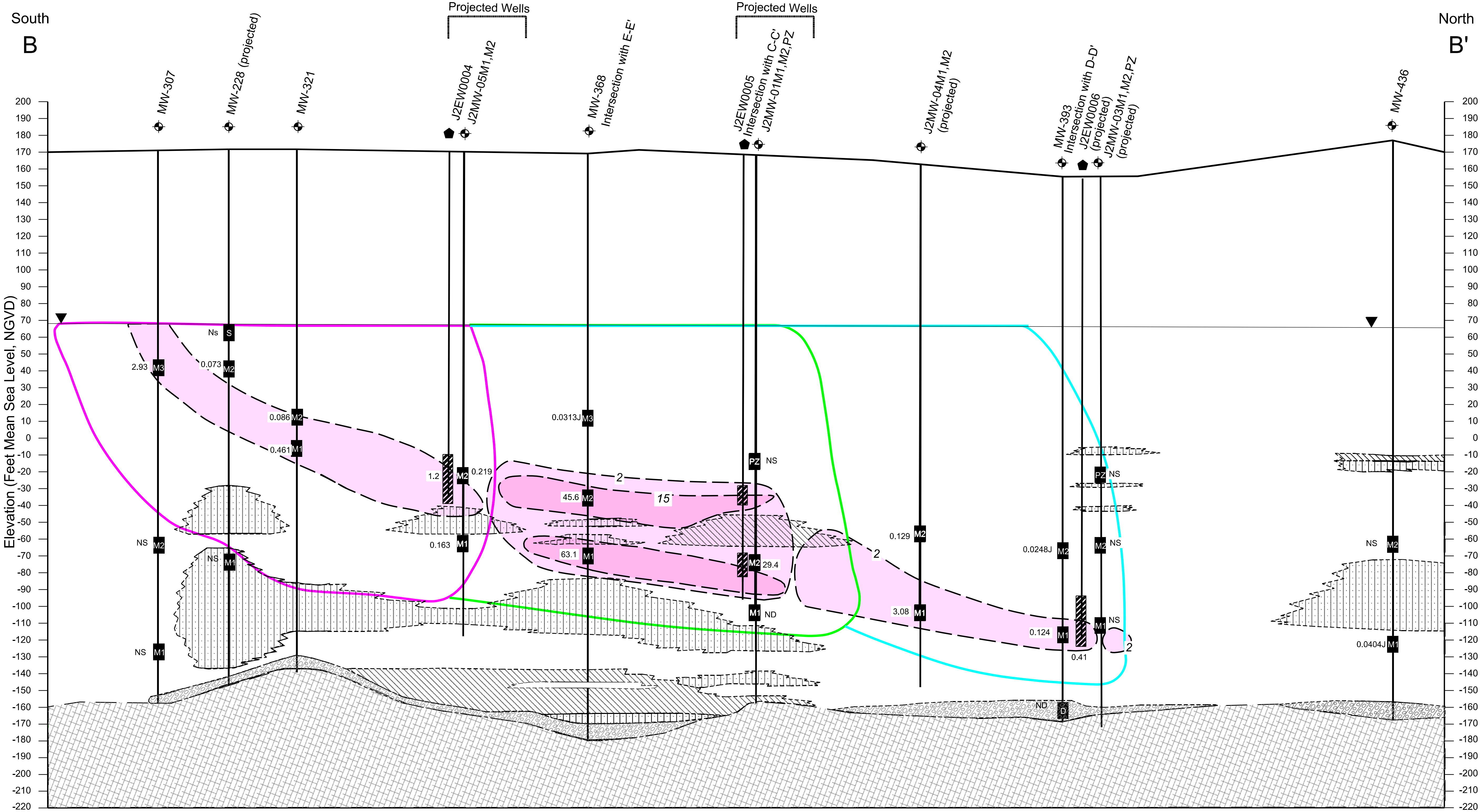
M:\MMR\2011\J-2East\AnnRpt\MXDs\Fig5-1_111711.mxd
November 17, 2011 DWN: MTW CHKD: KJH



Legend

Monitoring Well	
Proposed Extraction Well	
Water table	
Well screen ID	
Extraction Well Screen	

J	Estimated Concentration
ND	Nondetect
μg/L	Micrograms per liter
NS	Not Sampled
NGVD	National Geodetic Vertical Datum

Note: Validated monitoring well results shown to left of well screen ID.

- Sand
- Silt/ Clay
- Sand and Silt/Clay
- Basal Gravel/Sand
- Bedrock

J-2 Range Eastern Plume

- 2-15 μg/L
- 15-200 μg/L

Data Sources: ECC/Jacobs, 8 May 2009, Site Environmental Evaluation (SEE) Database. Water level from 2003 Synoptic Event.

- Vertical Capture Zone for J2ew0001 2011 Operational Conditions
- Vertical Capture Zone for J2ew0002 2011 Operational Conditions
- Vertical Capture Zone for J2ew0003 2011 Operational Conditions

— Geologic Contact (dashed where inferred)

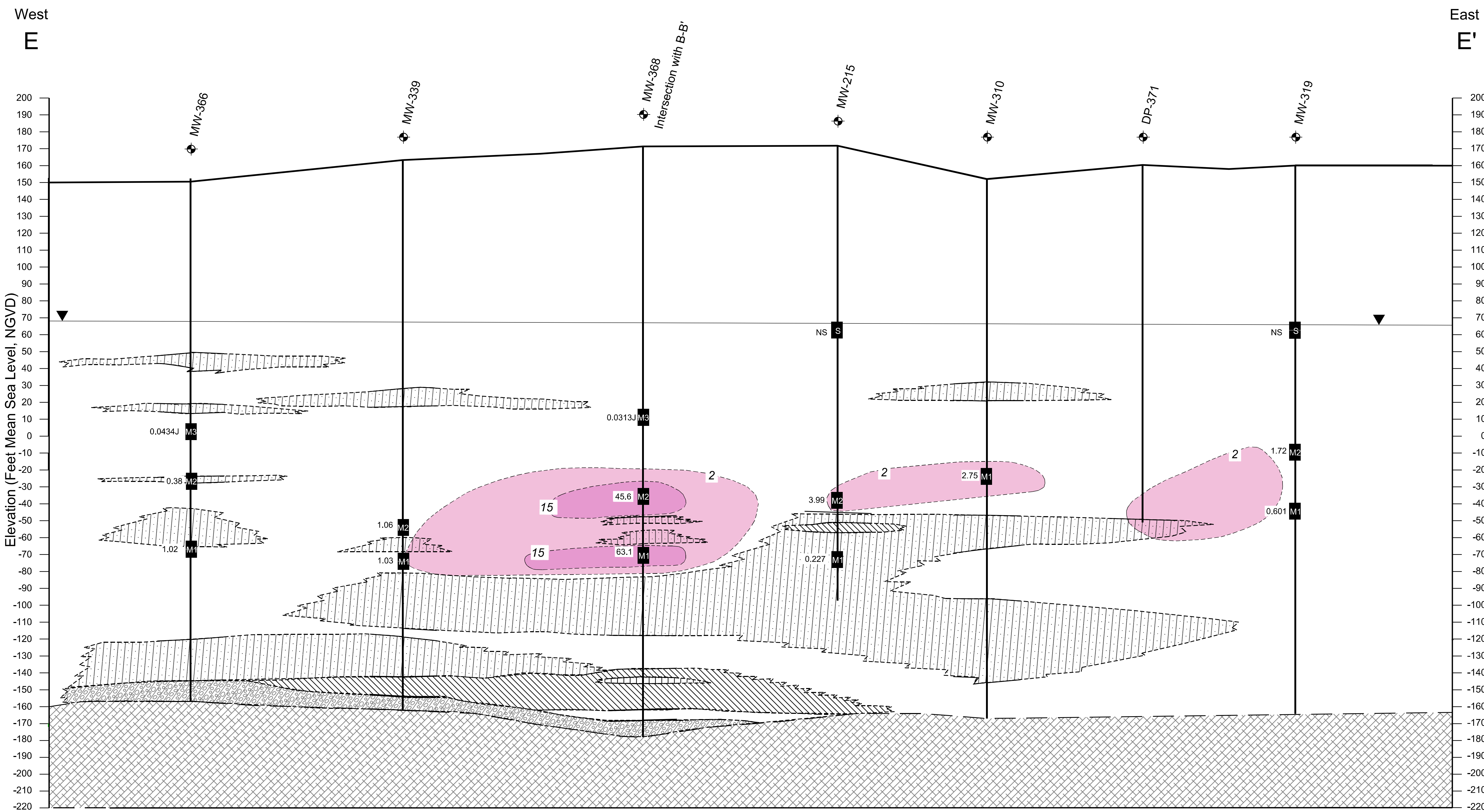
0 V: 60 H: 500

Scale in Feet

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

MASSACHUSETTS MILITARY RESERVATION
CAPE COD. MASSACHUSETTS
IMPACT AREA GROUNDWATER
STUDY PROGRAM
J-2 RANGE
EASTERN PLUME CROSS SECTION B-B'
ILLUSTRATING PERCHLORATE DISTRIBUTIONS

DATE: 05/25/2012	FILE NAME:	FIGURE 5-2
PLOT SCALE: 1"=60'-0"	J2E_PER_BB_Fig-5-2-05-25-12.DGN	



Legend

- Monitoring Well
- Water table
- Well screen ID

NS Not Sampled
J Estimated Concentration
ND Nondetect
µg/L Micrograms per liter
NGVD National Geodetic Vertical Datum

Sand
Silt/ Clay
Sand and Silt/Clay
Basal Gravel/Sand
Bedrock

2-15 µg/L
15-200 µg/L

— Geologic Contact (dashed where inferred)

Note: Validated monitoring well results shown to left of well screen ID.

Data Sources: ECC/Jacobs, 8 May 2009, Site Environmental Evaluation (SEE) Database. Water level from 2003 Synoptic Event.

V: 60
H: 300
0
Scale in Feet

Impact Area Groundwater Study Program

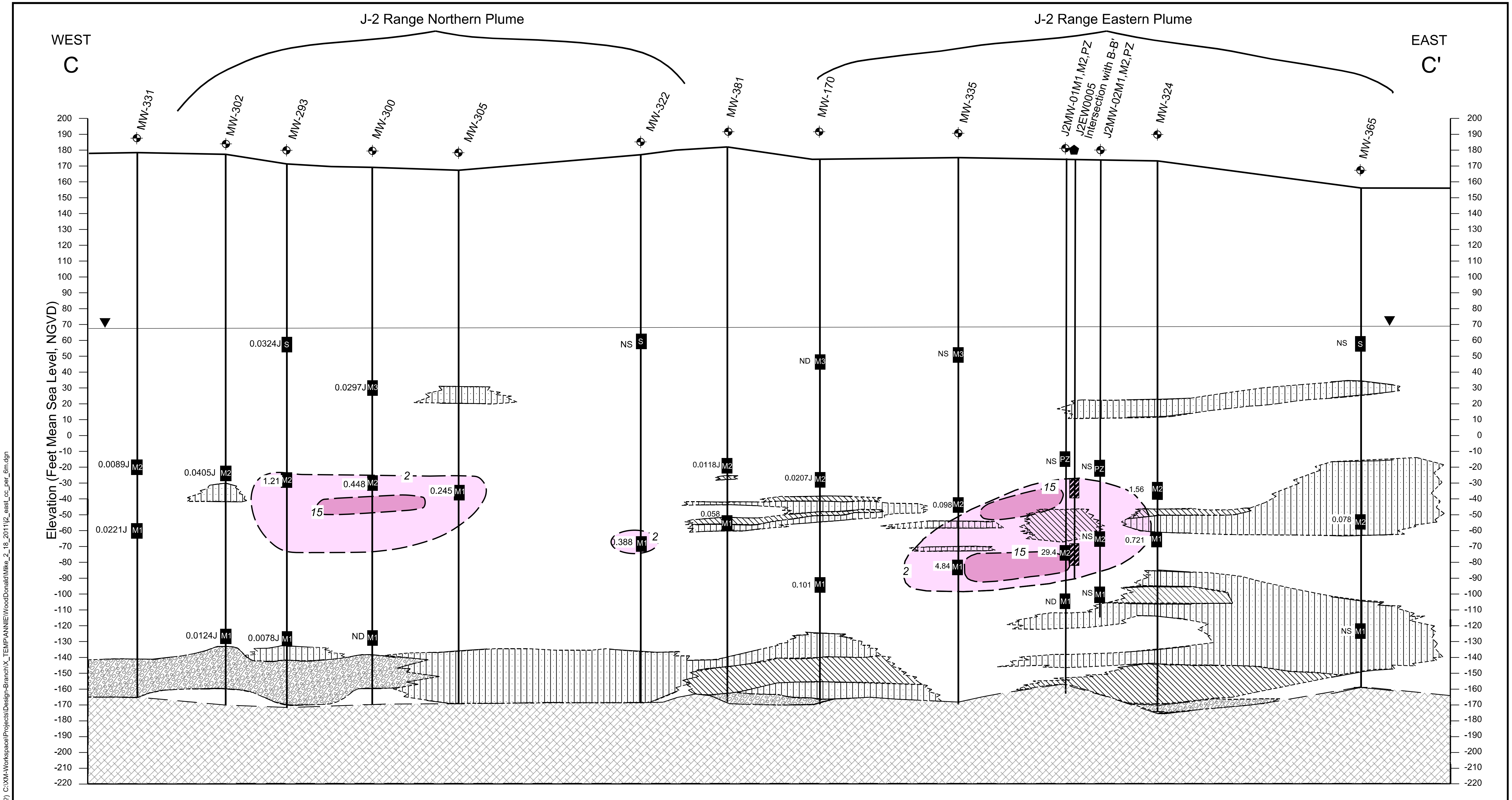
J-2 Range Eastern Plume Cross Section E-E' Illustrating Perchlorate Distributions

Massachusetts Military Reservation
Cape Cod, Massachusetts

10/04/2011 E6 j2_east_per_ee_6m.dgn

Figure 5-3

last modified: 02/24/2011 printed: $(EDTIME,??) C:\XM-Workspace\Projects\Design-Branch\X_TEMP\ANNIE\WoodDonald\Mike_2_18_2011\j2_east_per_ee_6m.dgn



Legend

Monitoring Well	
Extraction Well	
Water table	
Well screen ID	
Extraction Well Screen	
NGVD	National Geodetic Vertical Datum

J	Estimated Concentration
ND	Nondetect
NS	Not Sampled
µg/L	Micrograms per liter

- Sand
- Silt/ Clay
- Sand and Silt/Clay
- Basal Gravel/Sand
- Bedrock

J-2 Range Eastern Plume

- 2-15 µg/L
- 15-200 µg/L
- J-2 Range East Perchlorate Plume (shown to 2 µg/L)

— Geologic Contact (dashed where inferred)

Note: Validated monitoring well results shown to left of well screen ID.

Data Sources: ECC/Jacobs, 9 May 2009, Site Environmental Evaluation (SEE) Database. Water level from 2003 Synoptic Event.

0 — Scale in Feet — V: 60 H: 400

Impact Area Groundwater Study Program

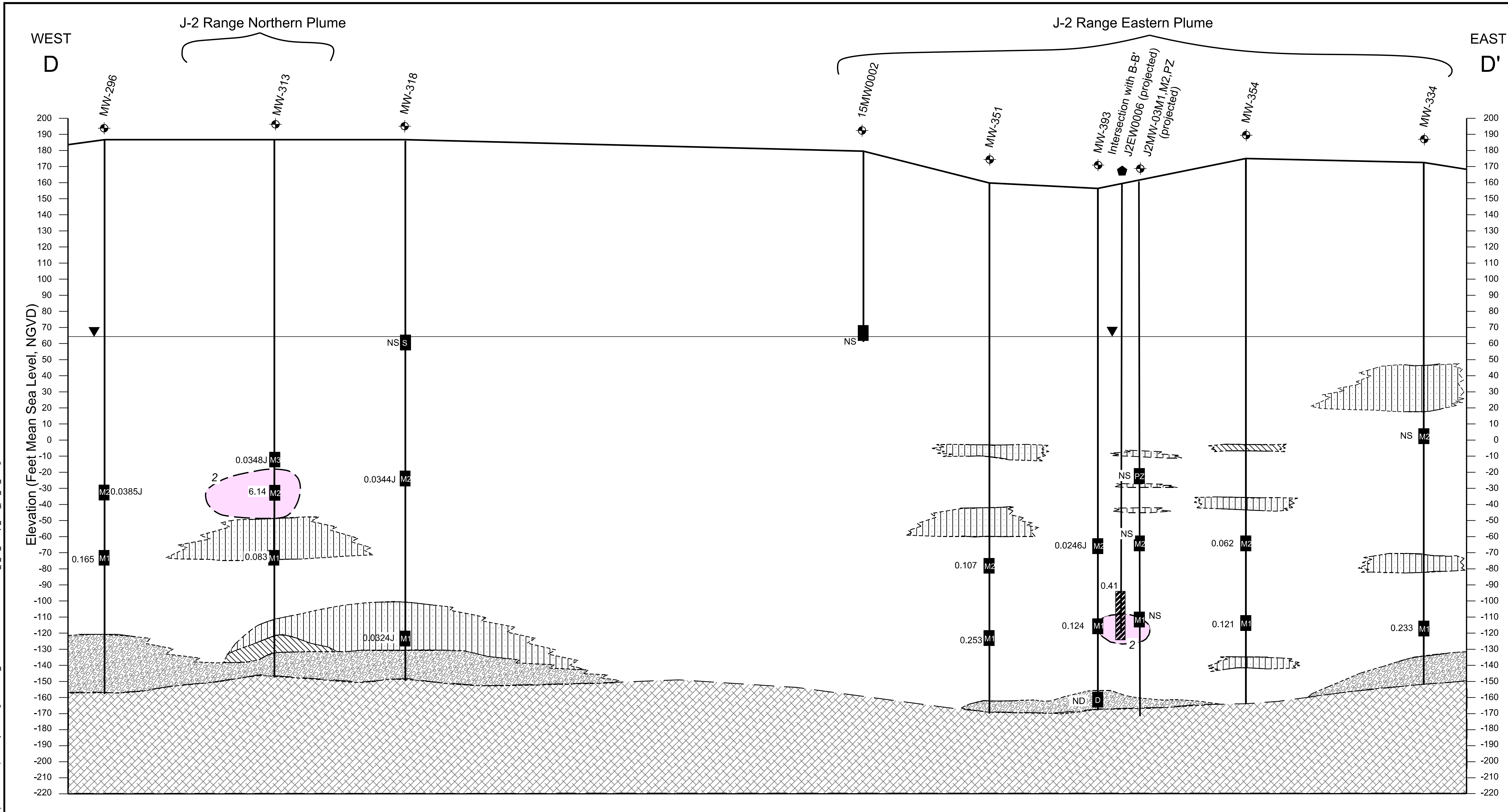
J-2 Range Eastern Plume Cross Section C-C' Illustrating Perchlorate Distributions

Massachusetts Military Reservation
Cape Cod, Massachusetts

11/16/2011 E6 j2_east_cc_per_6m.dgn

Figure 5-4

last modified: 02/24/2011 printed: $(EDTIME,??) C:\XM-Workspace\Projects\Design-Branch\X_TEMP\ANNIE\WoodDonald\Mike_2_18_2011\j2_east_cc_per_6m.dgn



Legend

- Monitoring Well
- Proposed Extraction Well
- Water table
- Well screen ID
- Extraction Well Screen

NS	Not Sampled
J	Estimated Concentration
ND	Nondetect
µg/L	Micrograms per liter
NGVD	National Geodetic Vertical Datum

- Sand
- Silt/ Clay
- Sand and Silt/Clay
- Basal Gravel/Sand
- Bedrock

J-2 Range Eastern Plume

- 2-15 µg/L
- 15-200 µg/L
- J-2 Range East Perchlorate Plume (shown to 2 µg/L)
- Geologic Contact (dashed where inferred)

Note: Validated monitoring well results shown to left of well screen ID.

Data Sources: ECC/Jacobs, 8 May 2009, Site Environmental Evaluation (SEE) Database. Water level from 2003 Synoptic Event.

V: 60
H: 400
0
Scale in Feet

Impact Area Groundwater Study Program

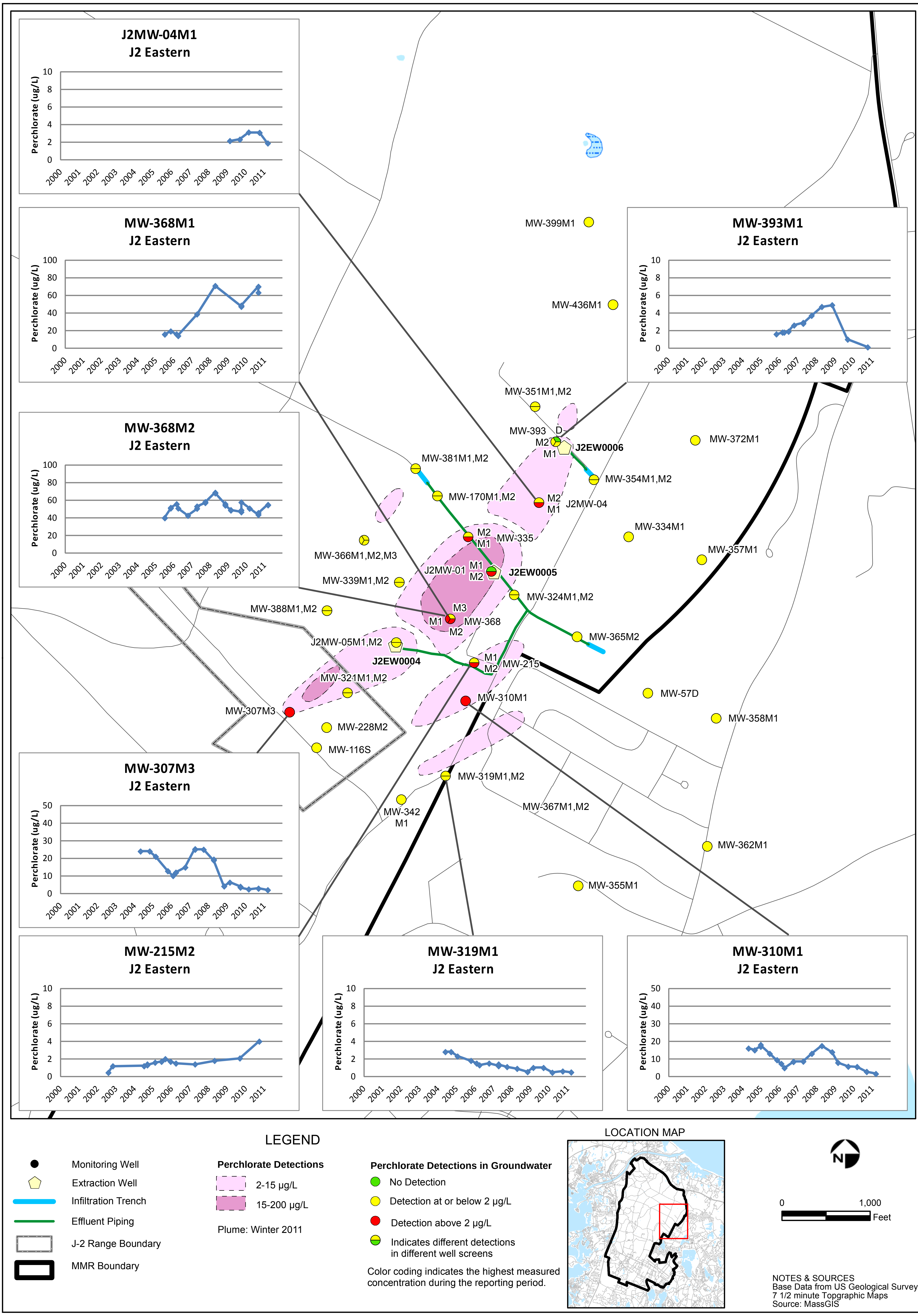
J-2 Range Eastern Plume Cross Section D-D' Illustrating Perchlorate Distributions

Massachusetts Military Reservation
Cape Cod, Massachusetts

11/16/2011 E6 j2_east_per_dd_6m.dgn

Figure 5-5

last modified: 02/24/2011 printed: $(EDTIME,??) C:\XM-Workspace\Projects\Design-Branch\X_TEMP\ANNIE\WoodDonald\Mike_2_18_2011\j2_east_per_dd_6m.dgn



US Army Corps of Engineers New England District

Impact Area Groundwater Study Program

J-2 Range Eastern Groundwater Perchlorate Trends

FIGURE 5-6

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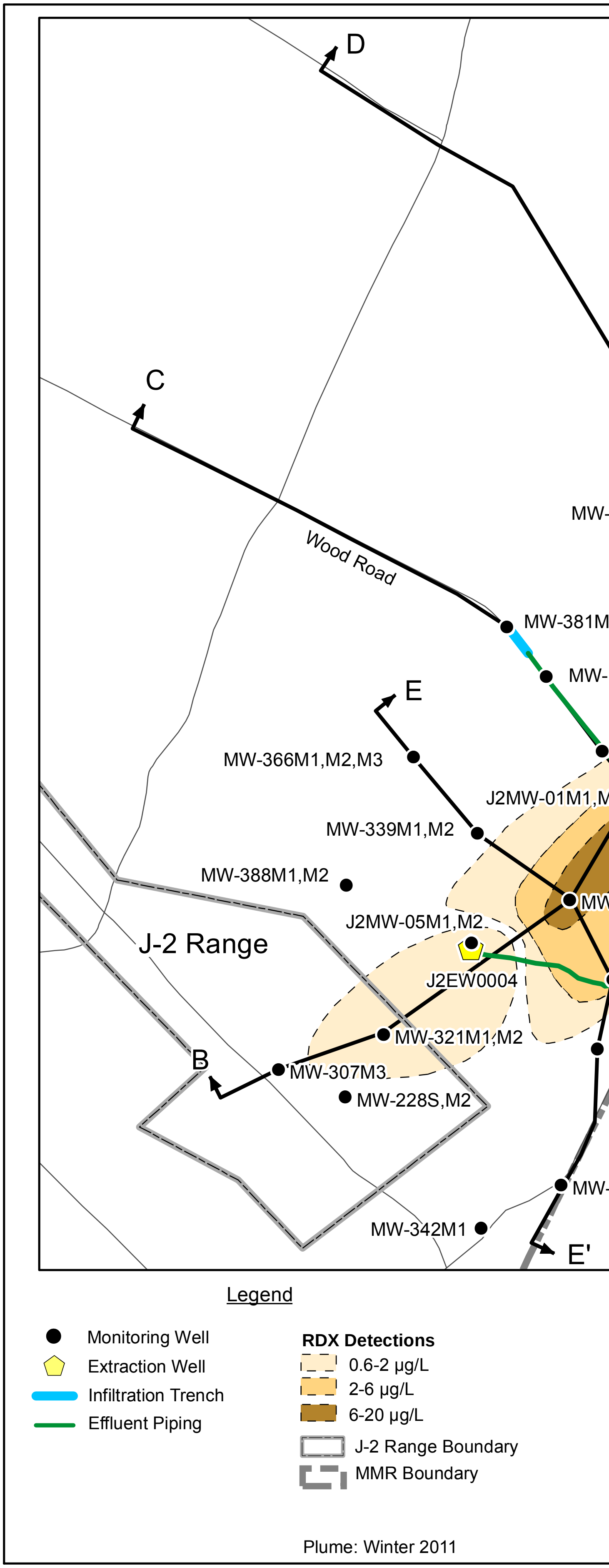
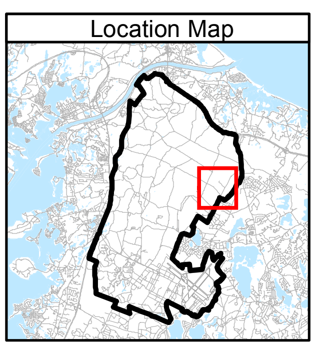
M:\MMR\2011\J-2East\AnnRpt\MXDs\Fig5-6_111711.mxd
May 24, 2012 DWN: MTW CHKD: KJH





TITLE

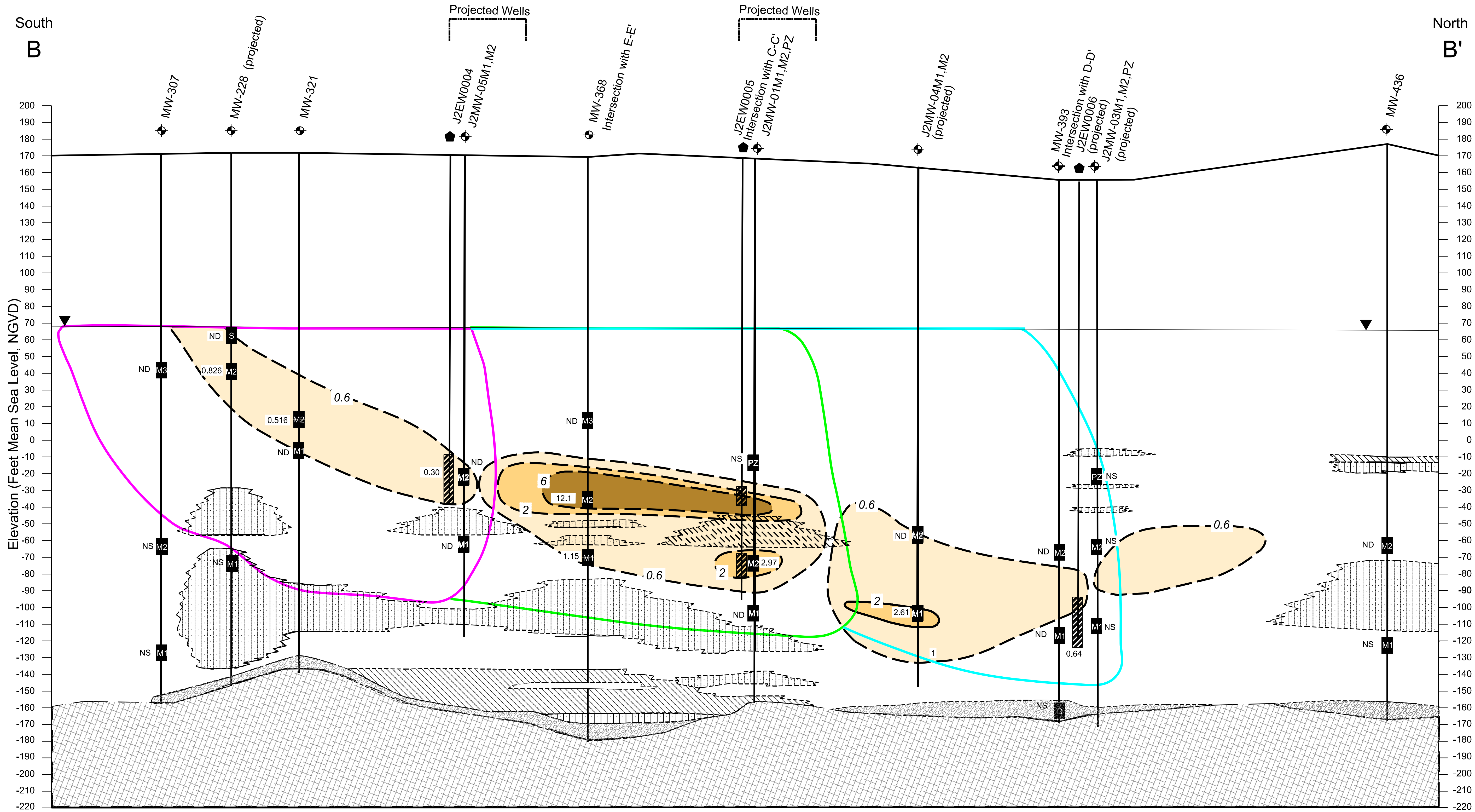
J-2 Range Eastern Plume
RDX Distribution and
Lines of Cross Section Location

US Army Corps of Engineers
New England District

Impact Area
Groundwater Study Program

FIGURE
5-7

M:\MMR\2011\J-2East\AnnRpt\Figures\Fig5-7_111711.pdf
M:\MMR\2011\J-2East\AnnRpt\MXDs\Fig5-7_111711.mxd
November 17, 2011 DWN: MTW CHKD: KJH



Legend

Extraction Well	Sand	NS	Not Sampled	0.6-2 μg/L	Vertical Capture Zone for J3EWIP1 2011 Operational Conditions	
Monitoring Well	Silt/ Clay	J	Estimated Concentration	2-20 μg/L	Vertical Capture Zone for J3EW0032 2011 Operational Conditions	
Water table	Sand and Silt/Clay	ND	Nondetect	20-200 μg/L	Vertical Capture Zone for 90ew0001 2011 Operational Conditions	— Geologic Contact (dashed where inferred)
Well screen ID	Basal Gravel/Sand	μg/L	Micrograms per liter			
Extraction Well Screen	Bedrock	NGVD	National Geodetic Vertical Datum			

Note: The most downgradient lobe is projected from the west of the cross section.

Data Source: IAGWSP EDMS Database, Water level from 2003 Synoptic Event.

HORIZONTAL SCALE: 1"=500'
0' 250' 500'

0' 30' 60'
VERTICAL SCALE: 1"=60'

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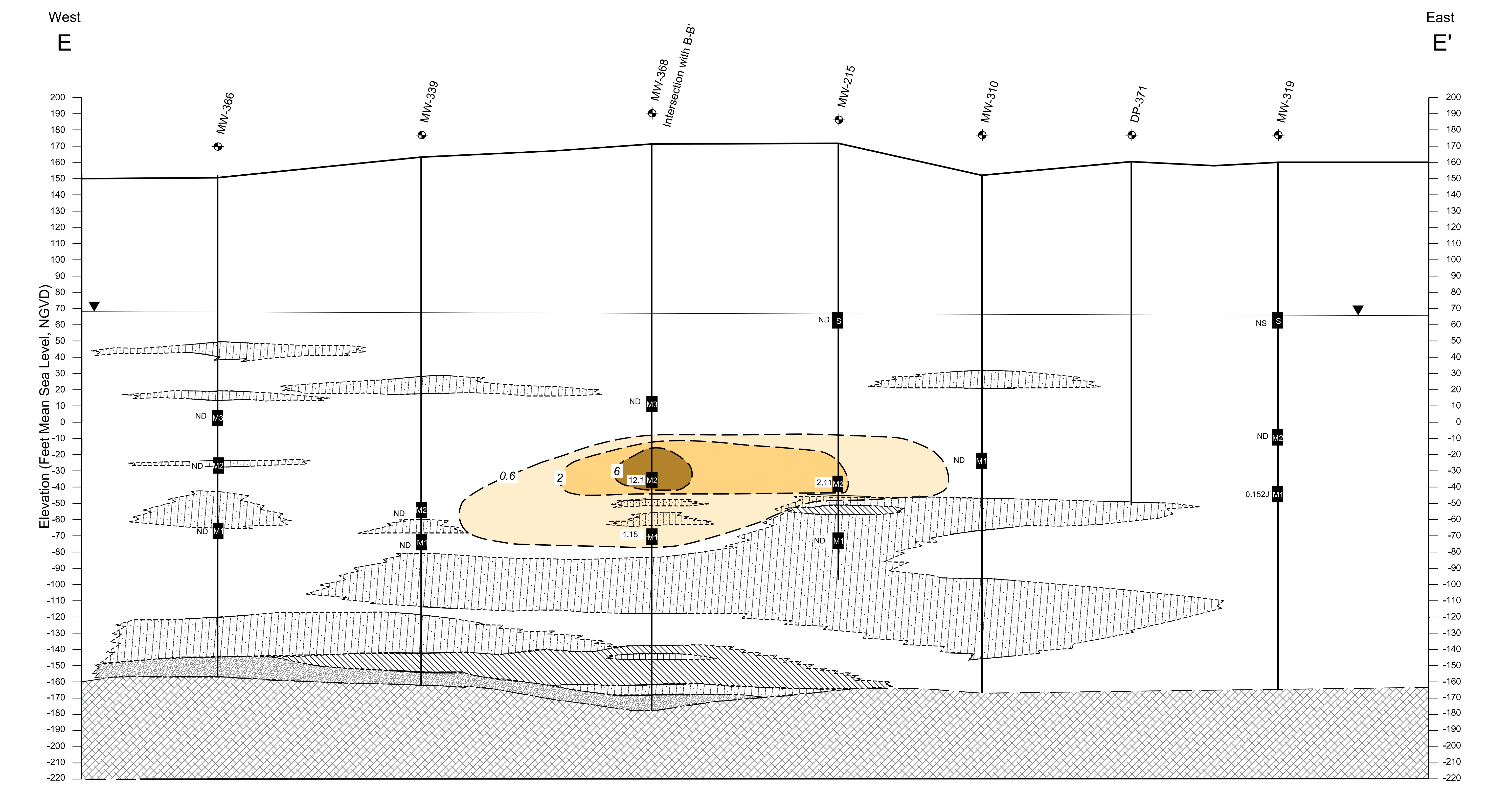
MASSACHUSETTS MILITARY RESERVATION
CAPE COD. MASSACHUSETTS
IMPACT AREA GROUNDWATER
STUDY PROGRAM
J-2 RANGE EASTERN
PLUME CROSS SECTION B-B'
RDX DISTRIBUTION IN
GROUNDWATER FROM AUGUST 2010 AND FEBRUARY 2011

DATE: 05/25/2012
PLOT SCALE: 1"=60'-0"
FILE NAME: J2E_RDX_BB_Fig5-8_05-25-12.DGN
FIGURE 5-8



last modified: 02/24/2011 printed: $(EDTIME,??) C:\XM-Workspace\Projects\Design-Branch\X_TEMP\ANNIE\WoodDonald\Mike_2_18_2011\j2_east_rdx_ee_6m.dgn

Legend

Monitoring Well	SD	Not Sampled	Sand	0.6-2 µg/L
Water table	J	Estimated Concentration	Silt/ Clay	2-20 µg/L
M1 Well screen ID	ND	Nondetect	Sand and Silt/Clay	6-20 µg/L
	µg/L	Micrograms per liter	Basal Gravel/Sand	
NGVD National Geodetic Vertical Datum			Bedrock	Geologic Contact (dashed where inferred)

Note: Validated monitoring well results shown to left of well screen ID.

Data Sources: ECC/Jacobs, 8 May 2009, Site Environmental Evaluation (SEE) Database. Water level from 2003 Synoptic Event.

0 Scale in Feet V: 60 H: 300

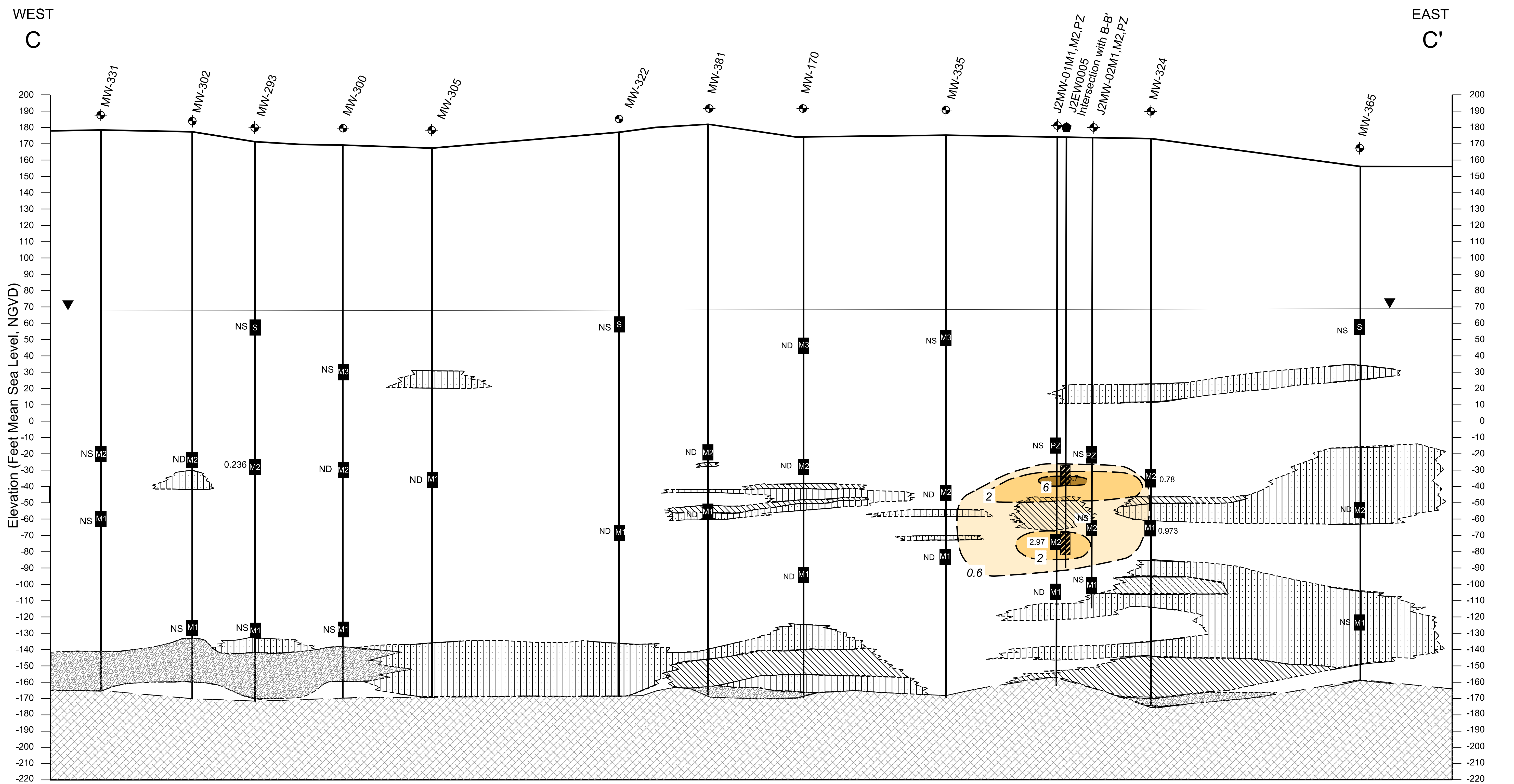
Impact Area Groundwater Study Program

J-2 Range Eastern Plume Cross Section E-E' Illustrating RDX Distributions

Massachusetts Military Reservation
Cape Cod, Massachusetts

10/03/2011 E6 j2_east_rdx_ee_6m.dgn

Figure 5-9



Legend

Extraction Well	Sand	NS	Not Sampled	0.6-2 μg/L
Monitoring Well	Silt/ Clay	J	Estimated Concentration	2-20 μg/L
Water table	Sand and Silt/Clay	ND	Nondetect	20-200 μg/L
Well screen ID	Basal Gravel/Sand	μg/L	Micrograms per liter	
Extraction Well Screen	Bedrock	NGVD	National Geodetic Vertical Datum	

— Geologic Contact (dashed where inferred)

Note: The most downgradient lobe is projected from the west of the cross section.

Data Source: IAGWSP EDMS Database, Water level from 2003 Synoptic Event.

HORIZONTAL SCALE: 1"=400'
0' 200' 400'

0' 30' 60'
VERTICAL SCALE: 1"=60'

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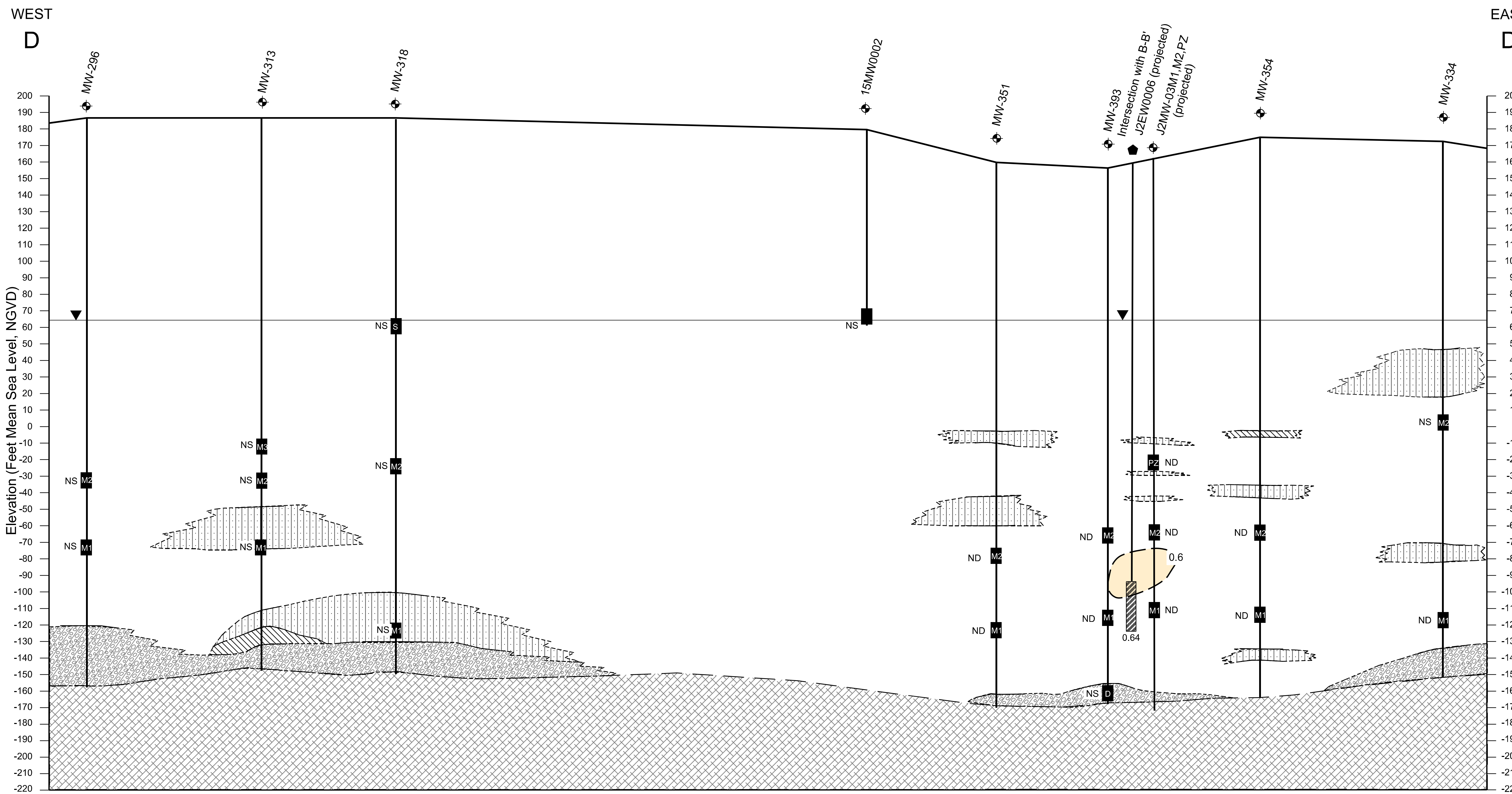
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

MASSACHUSETTS MILITARY RESERVATION
CAPE COD. MASSACHUSETTS
IMPACT AREA GROUNDWATER
STUDY PROGRAM
J-2 RANGE EASTERN
PLUME CROSS SECTION C-C'
RDX DISTRIBUTION IN
GROUNDWATER FROM SEPTEM 2010
AND MARCH 2011 OF AUGUST 2011

DATE: 12/13/2011
PLOT SCALE: 1"=60'-0"
FILE NAME: J2E_Fig5-10_121211.DGN

FIGURE 5-10



Legend

- Monitoring Well
- Proposed Extraction Well
- Water table
- M1 Well screen ID
- Extraction Well Screen

NS Not Sampled
J Estimated Concentration
ND Nondetect
μg/L Micrograms per liter

NGVD National Geodetic Vertical Datum

- Sand
- Silt/ Clay
- Sand and Silt/Clay
- Basal Gravel/Sand
- Bedrock
- 0.6-2 μg/L
- Geologic Contact (dashed where inferred)

Note: Validated monitoring well results shown to left of well screen ID.

Data Sources: ECC/Jacobs, 8 May 2009, Site Environmental Evaluation (SEE) Database. Water level from 2003 Synoptic Event.

V: 60
H: 400
0
Scale in Feet

Impact Area Groundwater Study Program

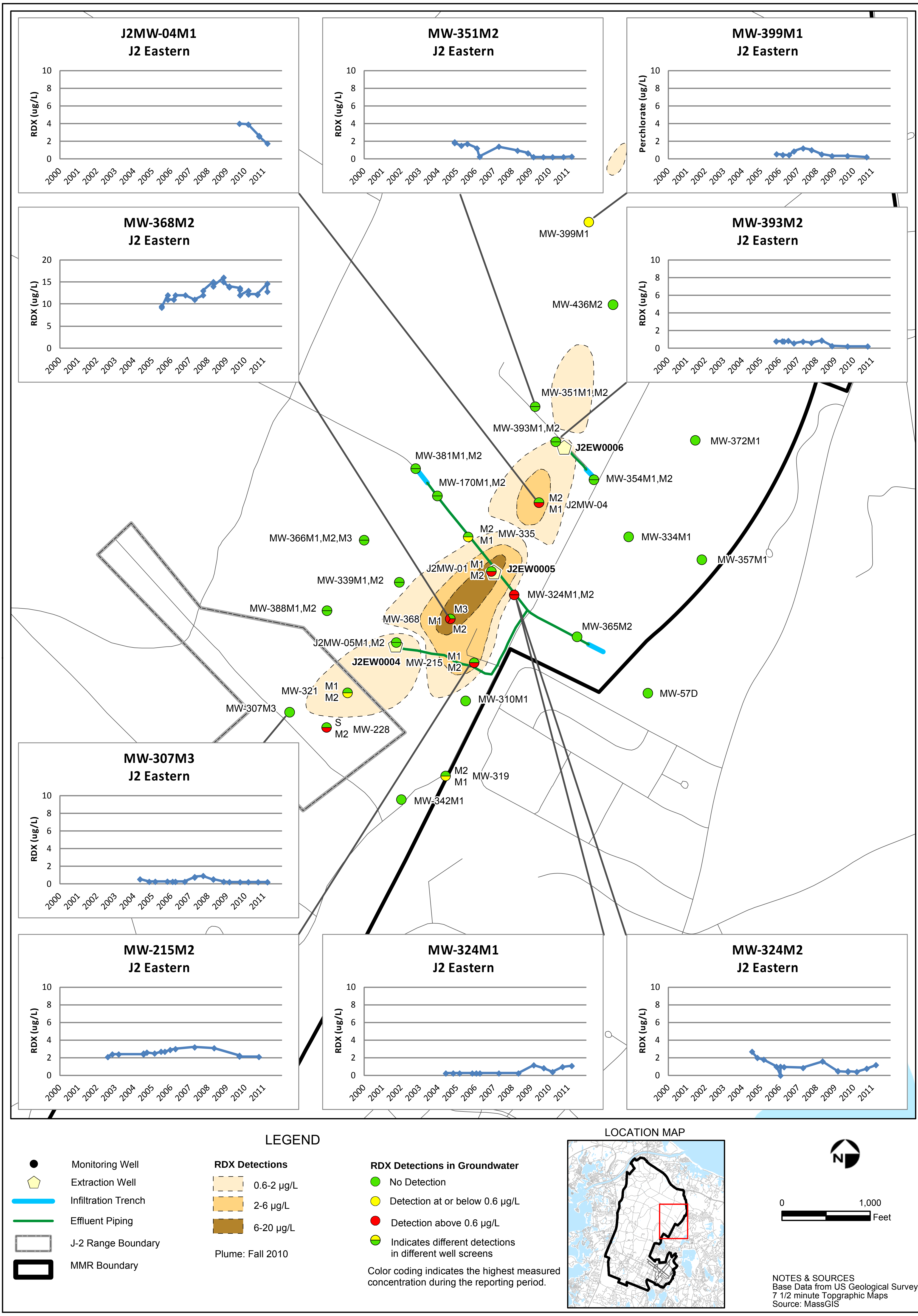
J-2 Range Eastern Plume Cross Section D-D' Illustrating RDX Distributions

Massachusetts Military Reservation
Cape Cod, Massachusetts

10/04/2011 E6 j2_east_rdx_dd_6m.dgn

Figure 5-11

last modified: 02/24/2011 printed: $(EDTIME,??) C:\XM-Workspace\Projects\Design-Branch\X_TEMP\ANNIE\WoodDonald\Mike_2_18_2011\j2_east_rdx_dd_6m.dgn



US Army Corps of Engineers® New England District

Impact Area Groundwater Study Program

J-2 Range Eastern Groundwater RDX Trends

FIGURE 5-12

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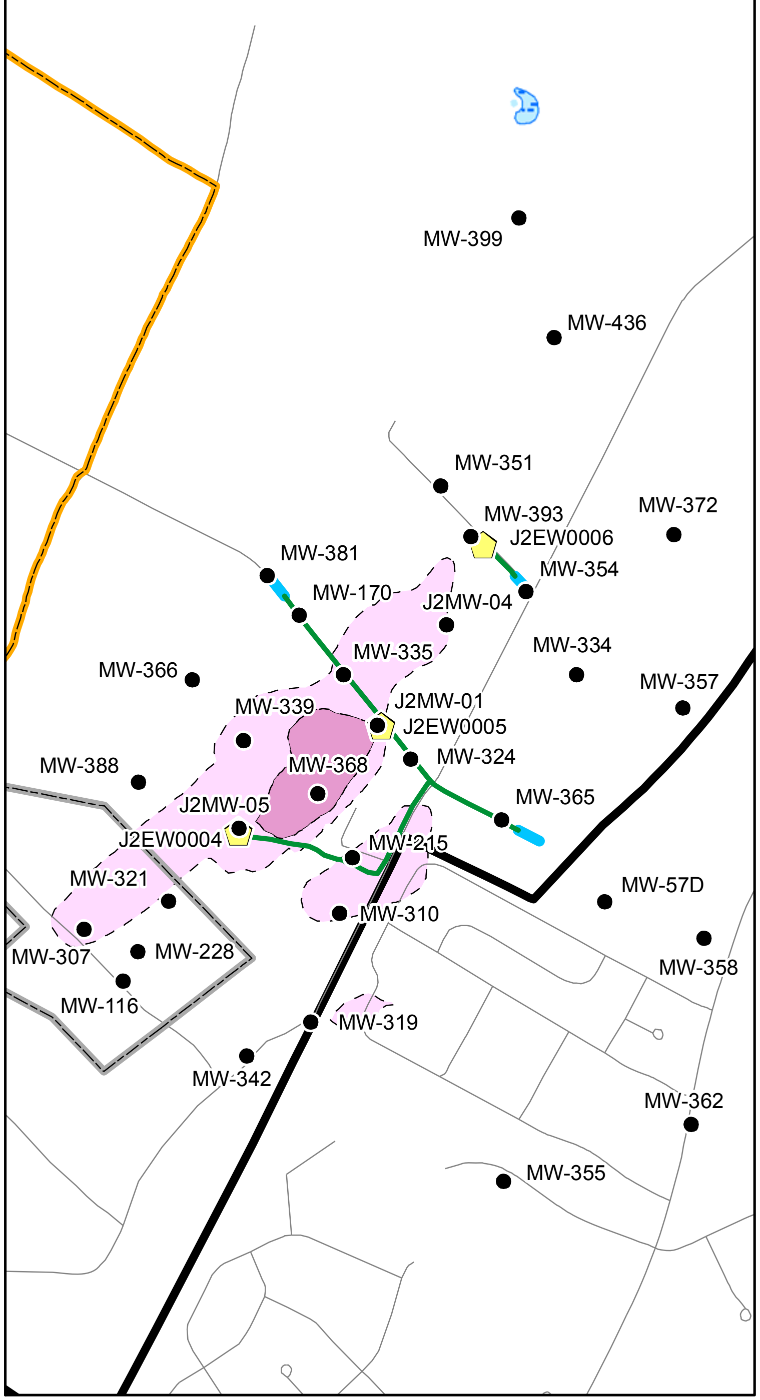
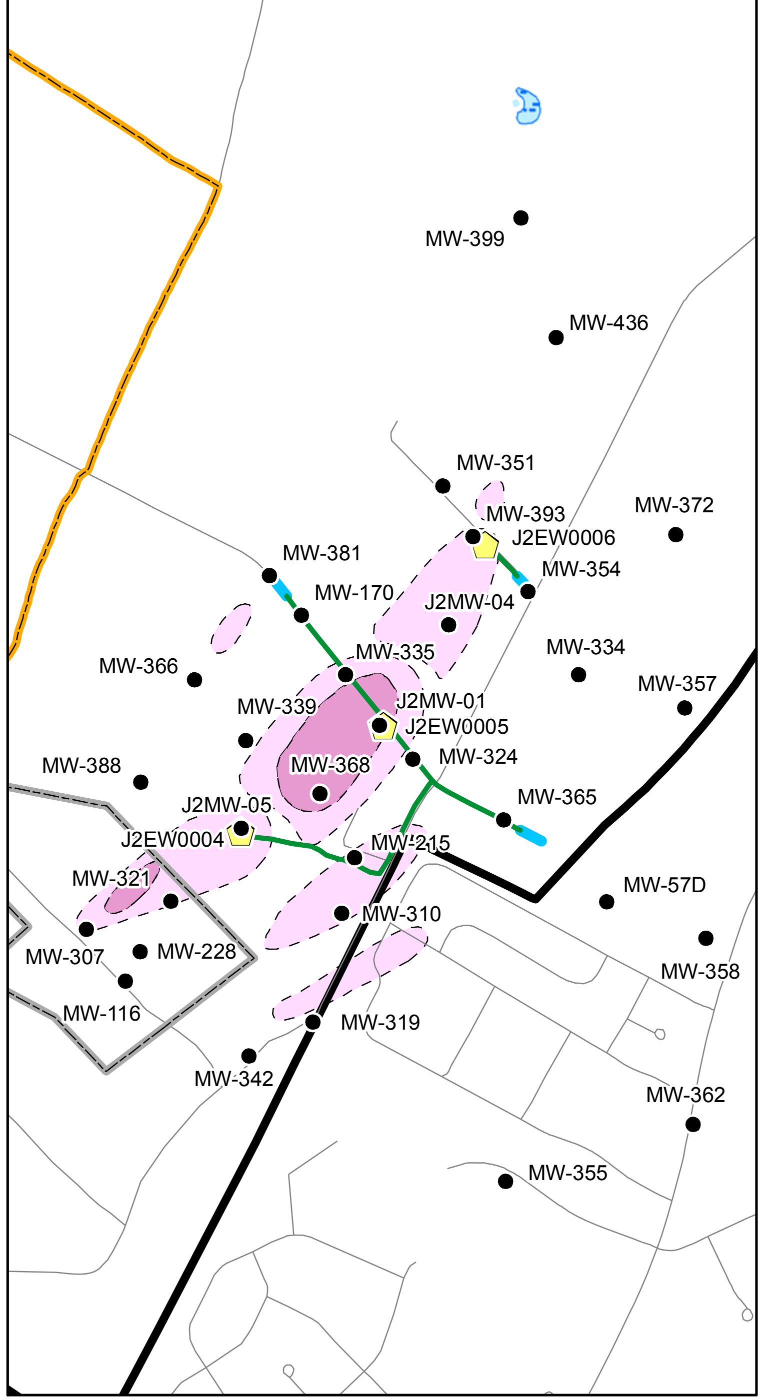
May 24, 2012 DWN: MTW CHKD: KJH

Model-Predicted 2011.25 Conditions (Based on J-2 East 2009.25 plume shells)



Observed Winter 2011 Conditions



Impact Area Groundwater Study Program

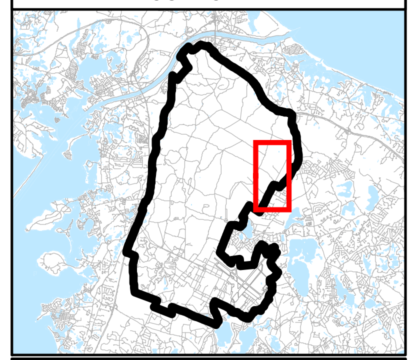
LEGEND

- Monitoring Well
- Extraction Well
- J-2 Range Boundary
- MMR Boundary

Perchlorate Detections

- 2-15 µg/L
- 15-200 µg/L

LOCATION MAP



NOTES & SOURCES

Map Coordinate System: NAD83 UTM Zone 19N Meters
Basemap data from US Geological Survey 7 1/2 minute Topographic Maps: Source: MassGIS

TITLE

J-2 Range Eastern Plume Perchlorate Model-Predicted and Observed Outline

0 1,500 Feet

N

US Army Corps of Engineers
New England District

FIGURE 6-1

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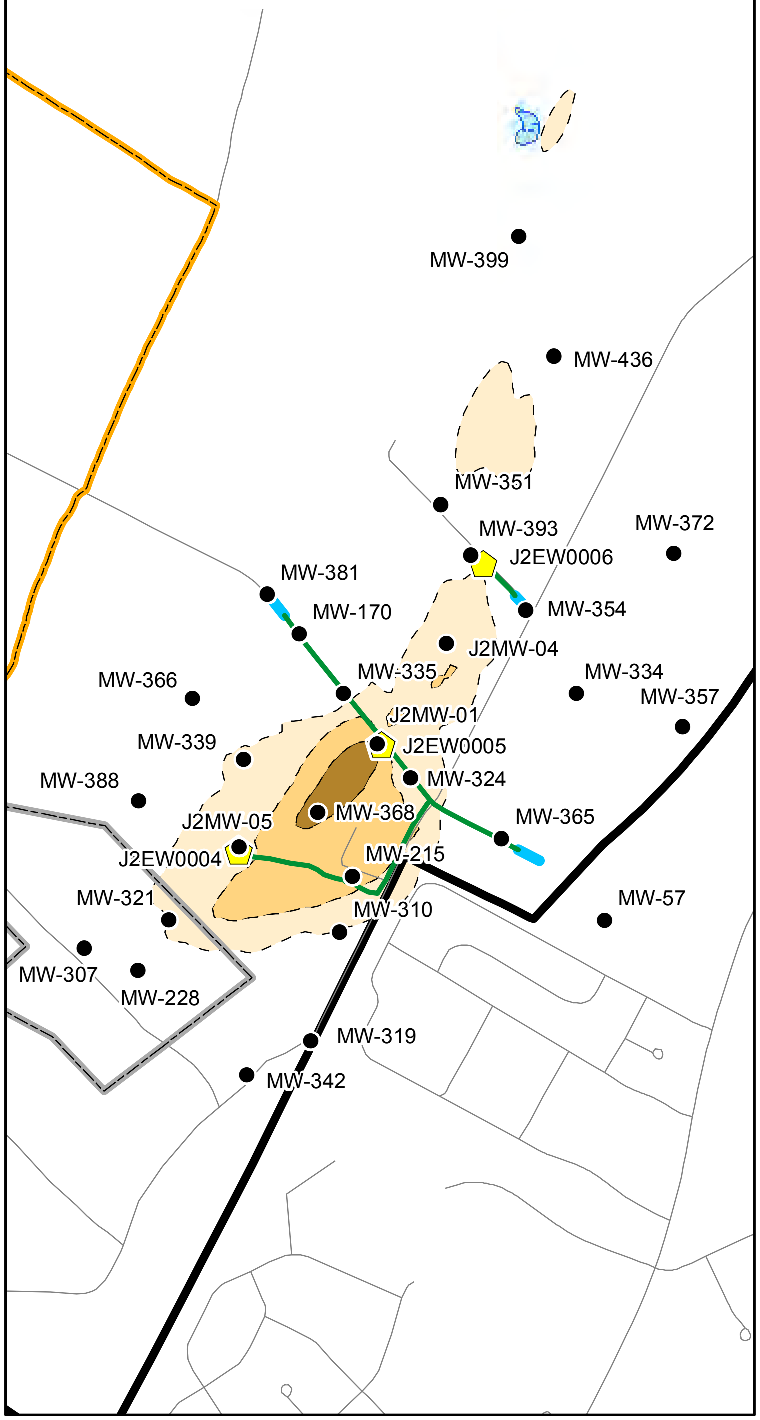
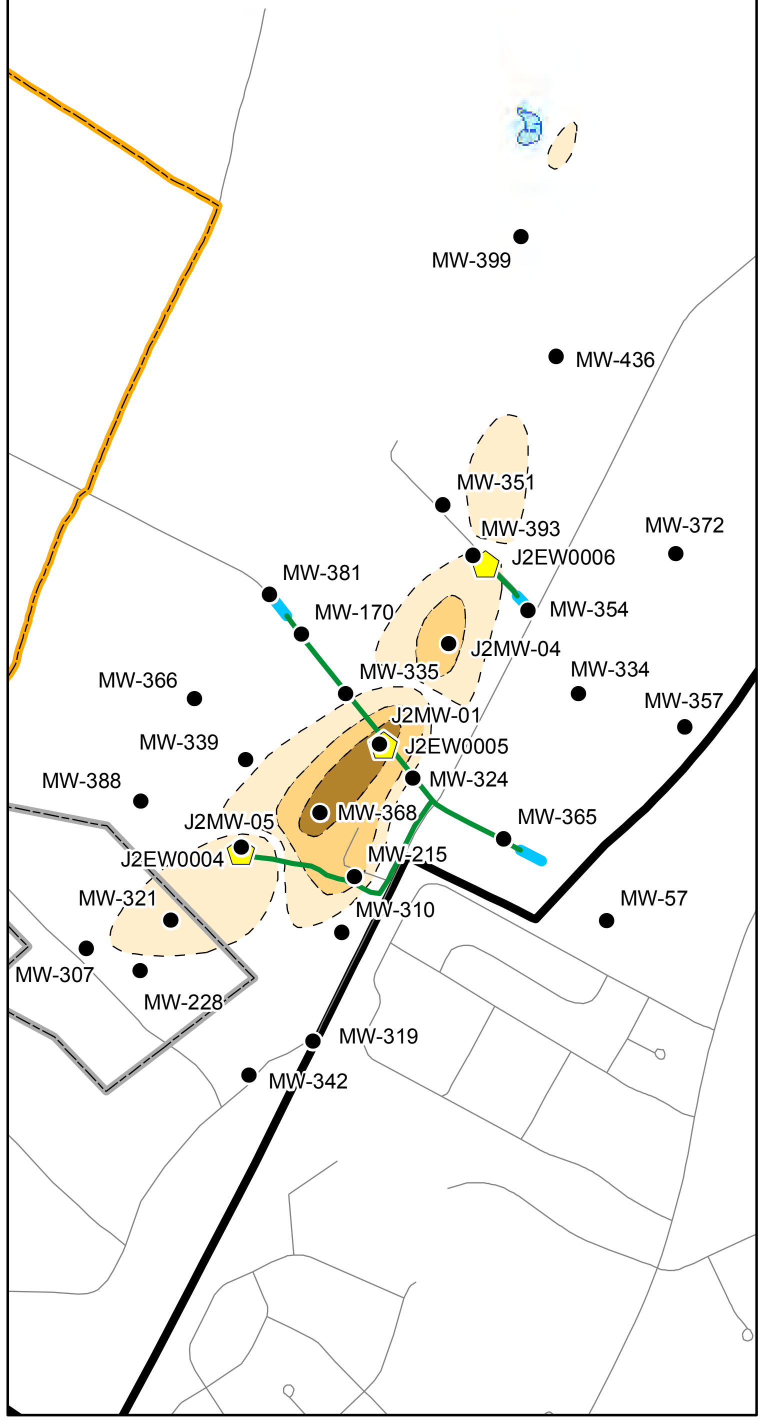
M:\MMR\2011\J-2East\AnnRpt\MXDs\Fig6-1_111711.mxd
November 17, 2011 DWN: MTW CHKD: KJH

Model-Predicted 2011.25 Conditions
(Based on J-2 East 2009.25 plume shells)



Observed Winter 2011 Conditions



Impact Area
Groundwater Study Program

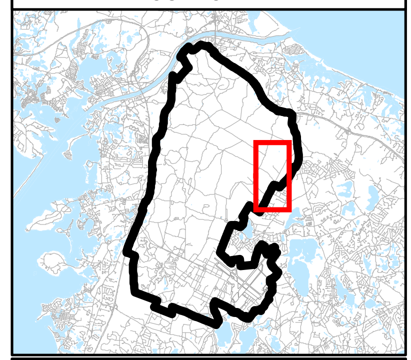
LEGEND

- Monitoring Well
- Extraction Well
- J-2 Range Boundary
- MMR Boundary

RDX Detections

- 0.6-2 µg/L
- 2-6 µg/L
- 6-20 µg/L

LOCATION MAP



NOTES & SOURCES

Map Coordinate System: NAD83 UTM Zone 19N Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Maps: Source: MassGIS

TITLE

J-2 Range Eastern Plume RDX
Model-Predicted and Observed Outline

0 1,500
Feet

N

US Army Corps of Engineers
New England District

FIGURE
6-2

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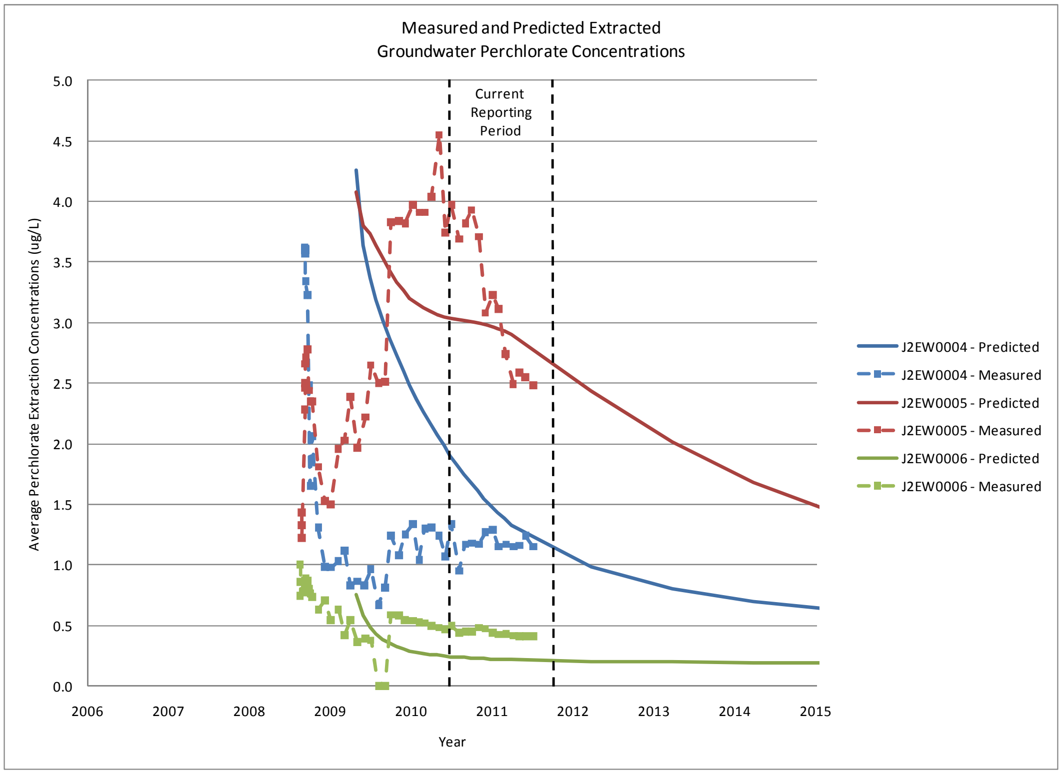
M:\MMR\2011\J-2East\AnnRpt\MXDs\Fig6-2_111711.mxd
November 17, 2011 DWN: MTW CHKD: KJH

Figure 6-3
J-2 Range Eastern Model Predicted and Observed Extracted Groundwater Concentrations



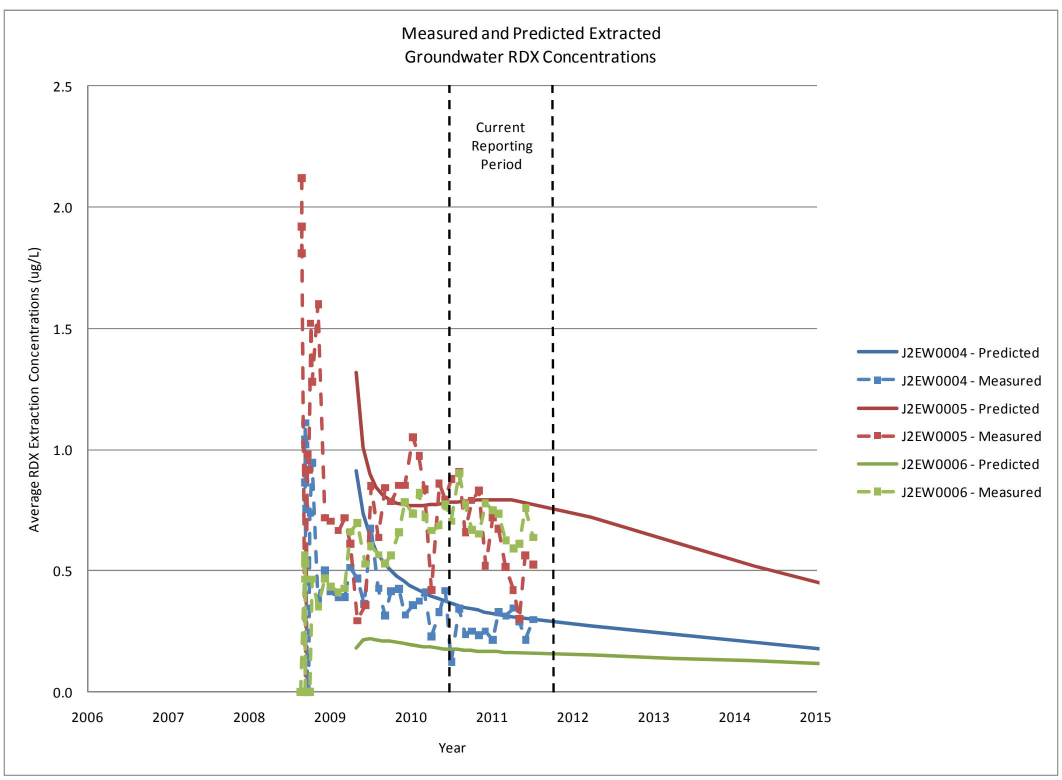
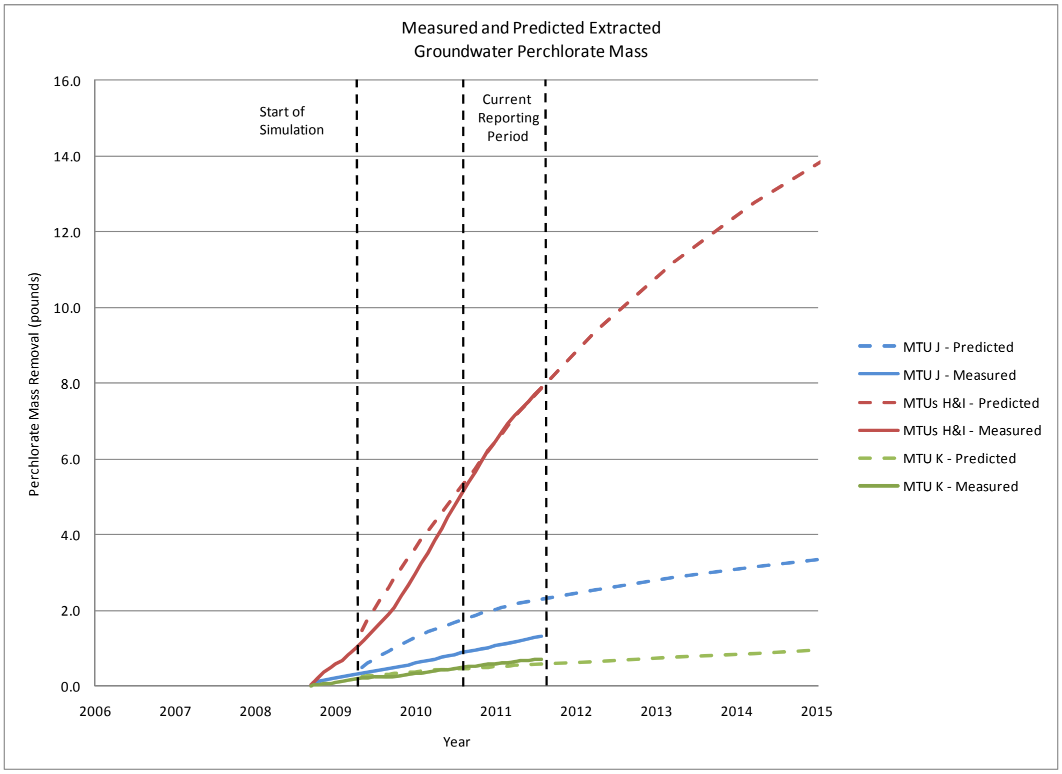
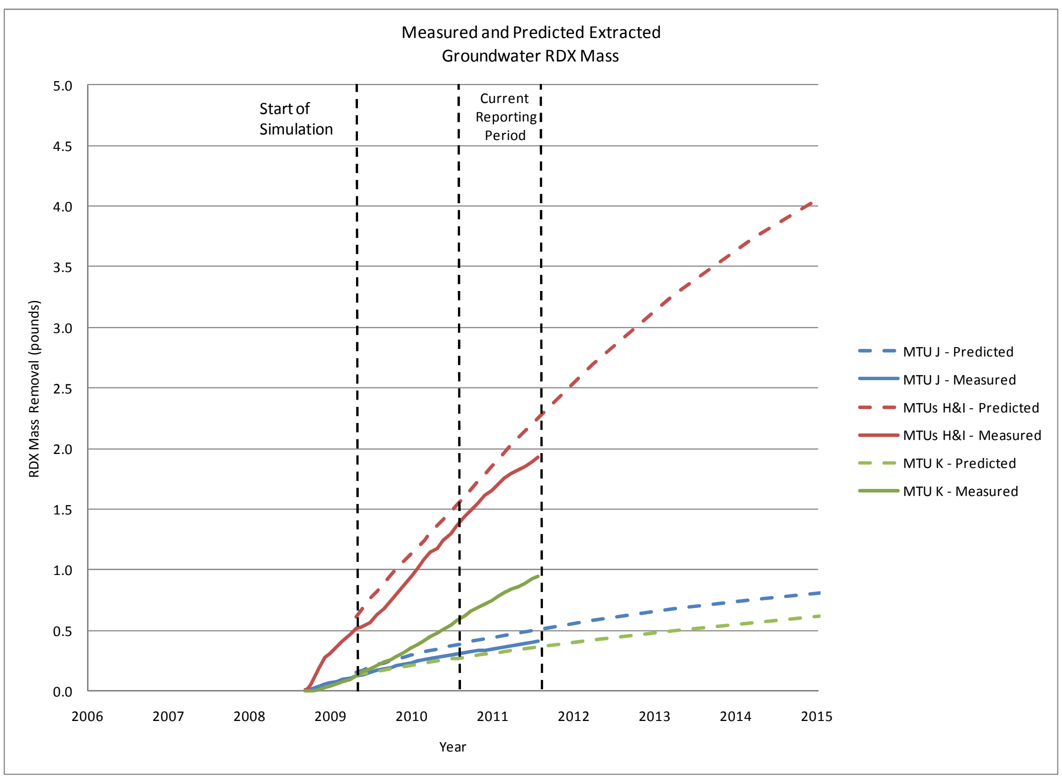
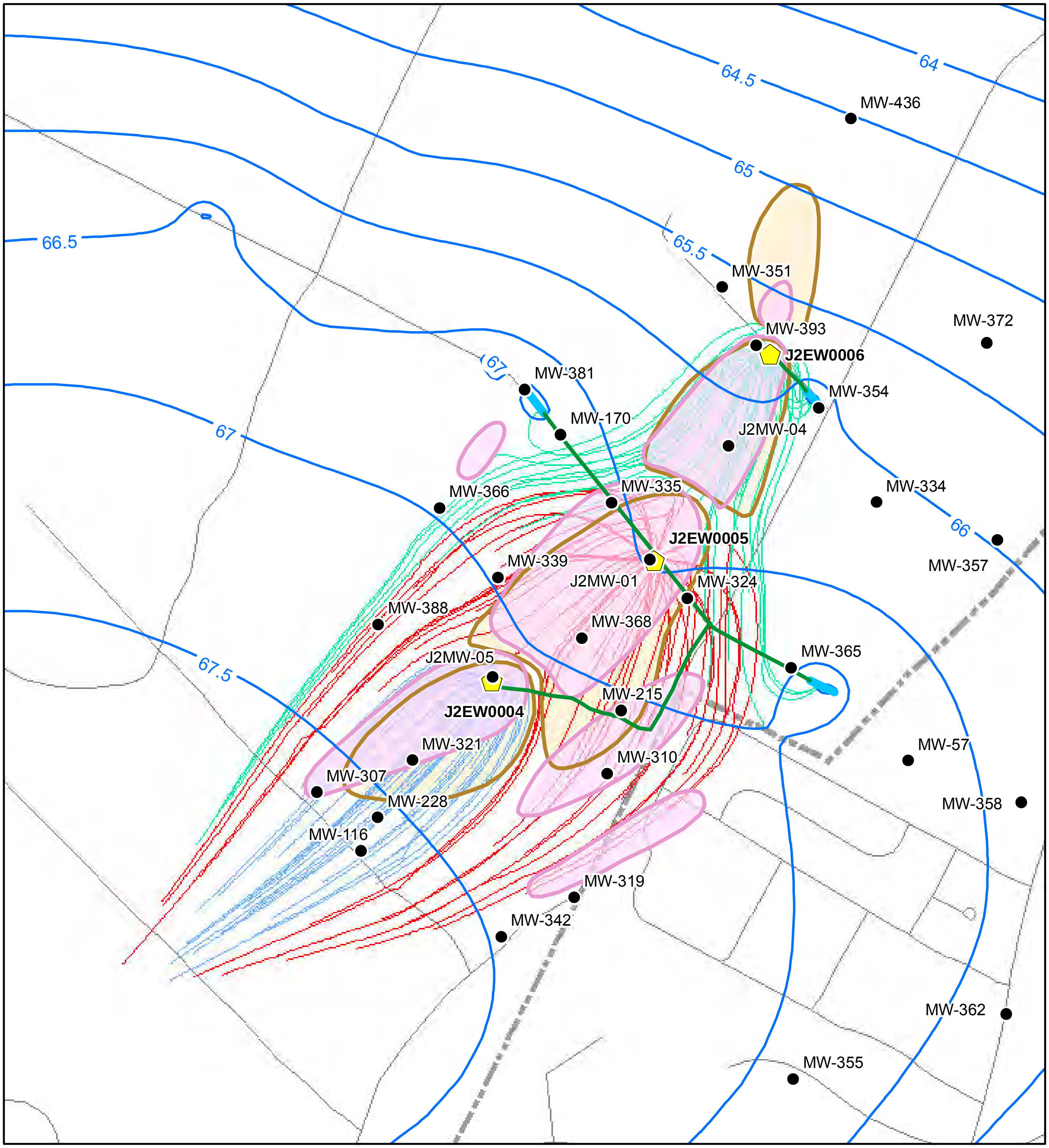


Figure 6-4

J-2 Range Eastern ERT System Model Predicted and Observed Mass Removal



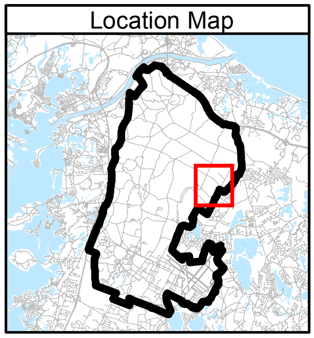




Legend

- Extraction Well
- J2EW0004 Capture Zone Particle Tracks
- J2EW0005 Capture Zone Particle Tracks
- J2EW0006 Capture Zone Particle Tracks
- Infiltration Trench
- Effluent Piping
- Perchlorate Plume Shown to 2 µg/L (Winter 2011)
- RDX Plume Shown to 0.6 µg/L (Winter 2011)
- MMR Boundary
- 66.5 Potentiometric Contours (Operational Conditions), 0.5 foot mean sea level intervals

Location Map



N

0 1,000 Feet

TITLE

Model-Predicted Capture Zone for J-2 Range Eastern 2010 Operational Conditions

US Army Corps of Engineers New England District

Impact Area Groundwater Study Program

FIGURE 6-5

M:\MMR\2011\J-2East\AnnRpt\Figures\Fig6-5_111711.pdf
M:\MMR\2011\J-2East\AnnRpt\MXDs\Fig6-5_111711.mxd
November 17, 2011 DWN: MTW CHKD: KJH

TABLES

Table 1-1:
J-2 Range Eastern Plume Groundwater Chemical Monitoring Network

Location	Northing Coordinate (N83UTM m)	Easting Coordinate (N83UTM m)	Surface Elevation (ft msl)	Screen Interval (ft msl)	Rationale for Location	Frequency (a)	Parameters (b)
J2EW0004	4,618,102	374,430	166.76	-8.24 to -38.254	Extraction well for J-2 Range eastern ETI system, used to help calculate and confirm mass removal by the system. The sample is collected at the influent port to the MTU (J2E-INF-J).	M	Explosives, Perchlorate
J2EW0005	4,618,355	374,770	176.86	-28.14 to -39.14 and -68.14 to -82.14	Extraction well for J-2 Range eastern ETI system, used to help calculate and confirm mass removal by the system. The sample is collected at the influent port to the MTU (J2E-INF-I).	M	Explosives, Perchlorate
J2EW0006	4,618,787	375,013	163.16	-90 to -120	Extraction well for J-2 Range eastern ETI system, used to help calculate and confirm mass removal by the system. The sample is collected at the influent port to the MTU (J2E-INF-K).	M	Explosives, Perchlorate
J2MW-01M1	4,618,357	374,761	175.68	-99.32 to -109.32	Monitor the downgradient extent of the core of the RDX and perchlorate plumes.	A	Explosives, Perchlorate
J2MW-01M2	4,618,358	374,760	175.65	-69.35 to -79.35	Monitor the downgradient extent of the core of the RDX and perchlorate plumes.	A	Explosives, Perchlorate
J2MW-04M1	4,618,595	374,926	157.30	-99.70 to -109.70	Monitor the downgradient extent of the perchlorate plume.	S	Explosives, Perchlorate
J2MW-04M2	4,618,595	374,926	157.30	-52.70 to -62.70	Monitor the downgradient extent of the RDX plume.	S	Explosives, Perchlorate
J2MW-05M1	4,618,111	374,433	167.08	-57.92 to -67.92	Monitor the upgradient extent of the core of the plume.	A	Explosives, Perchlorate
J2MW-05M2	4,618,111	374,432	167.08	-17.92 to -27.92	Monitor the upgradient extent of the core of the plume.	A	Explosives, Perchlorate
MW-116S	4,617,747	374,157	172.65	-93.84 to -123.84	Monitor the potential source area for the perchlorate plume.	A	Perchlorate
MW-170M1	4,618,618	374,575	175.13	-89.87 to -99.87	Monitor the western extent of the RDX and perchlorate plumes.	A	Explosives, Perchlorate
MW-170M2*	4,618,618	374,575	175.13	-22.87 to -32.87	Sampled as part of the Former K Range groundwater monitoring.	A*	Explosives, Perchlorate
MW-215M1	4,618,041	374,702	171.88	-68.12 to -78.12	Monitor the lower boundary of the RDX and perchlorate plumes.	A	Explosives, Perchlorate
MW-215M2	4,618,041	374,702	171.88	-33.12 to -43.12	Monitor the core of the RDX and perchlorate plumes between areas of higher concentration gradients.	A	Explosives, Perchlorate
MW-228M2	4,617,817	374,192	172.22	46.22 to 36.22	Monitor the trailing edge of the RDX and perchlorate plumes.	A	Explosives, Perchlorate
MW-228S	4,617,817	374,192	172.22	68.22 to 58.22	Monitor the potential source area for the RDX plume.	S	Explosives
MW-307M3	4,617,870	374,064	172.86	47.06 to 37.04	Monitor the source of the RDX and perchlorate plumes.	S	Explosives, Perchlorate
MW-310M1	4,617,909	374,672	152.60	-18.8 to -28.81	Monitor the core of the RDX and perchlorate plumes in an area of higher concentration gradients.	A,S	Explosives, Perchlorate
MW-319M1	4,617,649	374,603	160.62	-39.63 to -49.63	Monitor the eastern boundary of the RDX and perchlorate plumes.	A,S	Explosives, Perchlorate
MW-319M2	4,617,650	374,603	160.62	-4.55 to -14.55	Monitor the upper boundary of the RDX plume and the eastern boundary of the perchlorate plume.	A	Explosives, Perchlorate
MW-321M1	4,617,937	374,264	173.38	-1.23 to -11.23	Monitor the trailing edge of the RDX and perchlorate plumes.	A	Explosives, Perchlorate
MW-321M2	4,617,937	374,264	173.38	17.71 to 7.71	Monitor the trailing edge of the RDX and perchlorate plumes.	A	Explosives, Perchlorate
MW-324M1	4,618,276	374,840	174.08	-60.77 to -70.77	Monitor the eastern portion of the RDX and perchlorate plumes.	S	Explosives, Perchlorate
MW-324M2	4,618,276	374,840	174.08	-29.66 to -40.66	Monitor the eastern portion of the RDX and perchlorate plumes.	S	Explosives, Perchlorate
MW-334M1	4,618,477	375,236	172.49	-112.51 to -122.51	Monitor cross gradient of main body of RDX and perchlorate plumes.	A	Explosives, Perchlorate

Table 1-1:
J-2 Range Eastern Plume Groundwater Chemical Monitoring Network

Location	Northing Coordinate (N83UTM m)	Easting Coordinate (N83UTM m)	Surface Elevation (ft msl)	Screen Interval (ft msl)	Rationale for Location	Frequency (a)	Parameters (b)
MW-335M1	4,618,476	374,681	177.52	-77.68 to -87.68	Monitor the western portion of the RDX and perchlorate plumes.	S	Explosives, Perchlorate
MW-335M2	4,618,476	374,681	177.52	-37.73 to -47.73	Monitor the western portion of the RDX and perchlorate plumes.	S	Explosives, Perchlorate
MW-339M1	4,618,319	374,443	168.84	-64.16 to -74.16	Monitor western boundary of the RDX and perchlorate plumes.	S	Explosives, Perchlorate
MW-339M2	4,618,319	374,443	168.84	-44.16 to -54.16	Monitor western boundary of the RDX and perchlorate plumes.	A	Explosives, Perchlorate
MW-342M1	4,617,568	374,450	149.93	-43.8 to -53.8	Monitor cross gradient to potential source areas for eastern plumelet of RDX and perchlorate.	A	Explosives, Perchlorate
MW-351M1	4,618,927	374,913	159.83	-118.81 to -128.81	Monitor western boundary of leading edge of RDX and perchlorate plumes.	A,S	Explosives, Perchlorate
MW-351M2	4,618,927	374,913	159.83	-73.84 to -83.84	Monitor western boundary of leading edge of RDX and perchlorate plumes.	S	Explosives, Perchlorate
MW-354M1	4,618,674	375,116	175.02	-99.5 to -109.5	Monitor the eastern boundary of leading edge of the RDX and perchlorate plumes.	A,S	Explosives, Perchlorate
MW-354M2	4,618,674	375,116	175.02	-59.78 to -69.78	Monitor the eastern boundary of leading edge of the RDX and perchlorate plumes.	S	Explosives, Perchlorate
MW-355M1	4,617,270	375,062	157.86	-62.14 to -72.14	Monitor groundwater crossgradient of the perchlorate plume.	A	Perchlorate
MW-357M1	4,618,397	375,489	167.29	-107.22 to -117.22	Monitor cross gradient of RDX and perchlorate plumes.	B	Explosives, Perchlorate
MW-358M1	4,617,849	375,539	161.68	-68.23 to -78.32	Monitor groundwater downgradient of the perchlorate plume.	B	Perchlorate
MW-362M1	4,617,406	375,508	159.43	-69.57 to -79.57	Monitor groundwater downgradient and cross gradient of the perchlorate plume.	B	Perchlorate
MW-365M2	4,618,131	375,057	156.16	-49.84 to -59.84	Monitor eastern boundary of the RDX and perchlorate plumes.	A	Explosives, Perchlorate
MW-366M1	4,618,465	374,321	153.13	-61.87 to -71.87	Monitor western boundary of the RDX and perchlorate plumes.	A	Explosives, Perchlorate
MW-366M2	4,618,465	374,321	153.13	-21.87 to -31.87	Monitor western boundary of the RDX and perchlorate plumes.	A	Explosives, Perchlorate
MW-366M3	4,618,465	374,321	153.13	8.13 to -1.87	Monitor western boundary of the RDX and perchlorate plumes.	A	Explosives, Perchlorate
MW-368M1	4,618,195	374,619	172.00	-65.35 to -75.35	Monitor the lower boundary of the RDX and perchlorate plumes.	A	Explosives, Perchlorate
MW-368M2	4,618,195	374,619	172.00	-30.73 to -40.73	Monitor the core of the RDX and perchlorate plumes.	S	Explosives, Perchlorate
MW-368M3	4,618,193	374,619	172.00	15.93 to 5.93	Monitor the upper boundary of the core of the RDX and perchlorate plumes.	A	Explosives, Perchlorate
MW-372M1	4,618,808	375,458	174.00	-99.05 to -109.05	Monitor downgradient of RDX and perchlorate plumes.	B	Explosives, Perchlorate
MW-381M1	4,618,711	374,499	182.00	-50.94 to -60.94	Monitor the leading edge of the western lobe of RDX and perchlorate plumes.	A	Explosives, Perchlorate
MW-381M2	4,618,711	374,499	182.00	-14.39 to -24.39	Monitor the leading edge of the western lobe of RDX and perchlorate plumes.	A	Explosives, Perchlorate
MW-388M1	4,618,222	374,200	140.00	-35.18 to -45.18	Monitor western boundary of the RDX and perchlorate plumes.	A	Explosives, Perchlorate
MW-388M2	4,618,222	374,200	140.00	-4.75 to -14.75	Monitor western boundary of the RDX and perchlorate plumes.	A	Explosives, Perchlorate
MW-393D	4,618,807	374,987	156.00	-157.56 to -167.56	Monitor the lower boundary of the perchlorate plume.	B	Perchlorate
MW-393M1	4,618,807	374,987	156.00	-112.02 to -122.02	Monitor the lower boundary of the RDX plume and the leading edge of the perchlorate plume.	A	Explosives, Perchlorate

Table 1-1:
J-2 Range Eastern Plume Groundwater Chemical Monitoring Network

Location	Northing Coordinate (N83UTM m)	Easting Coordinate (N83UTM m)	Surface Elevation (ft msl)	Screen Interval (ft msl)	Rationale for Location	Frequency (a)	Parameters (b)
MW-393M2	4,618,807	374,987	156.00	-62.16 to -72.16	Monitor the leading edge of the RDX plume and the upper boundary of the perchlorate plume.	A	Explosives, Perchlorate
MW-399M1	4,619,564	375,098	163.00	-74 to -84	Monitor downgradient of RDX and perchlorate plumes.	A	Explosives, Perchlorate
MW-436M1	4,619,279	375,182	177.01	-118.46 to -128.46	Monitor the leading edge of the perchlorate plume.	S	Perchlorate
MW-436M2	4,619,279	375,182	177.01	-58.44 to -68.44	Monitor the leading edge of the RDX plume.	S	Explosives
MW-57D	4,617,936	375,302	156.89	-56.11 to -66.11	Monitor downgradient of eastern lobe of RDX and perchlorate plumes.	A	Explosives, Perchlorate

Notes:
* = samples collected as part of the Former K Range groundwater monitoring program.
ft = feet
J-2 = J-2 Range
m = meter
msl = mean sea level
N83UTM = North American Datum 1983 Universal Transverse Mercator
RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine

A = annually
B = biennially
S = semiannually
M = monthly

(b)
Explosives = EPA Method SW846/8330
Perchlorate = EPA Method E314.0 or SW6850

Table 2-1
Plant Maintenance, Availability, and Downtime Summary

Month	Plant	Availability		Maintenance/Downtime for Period		
		Period	Start-up to Date	Pump Hours	Event	Date/Action
August 2010	MTU J	99.4%	99.5%	4.77	The system shutdown due to a storm caused power interruption.	The system shutdown, 0335 h on 17 August restarted at 0821 h.
	MTU K	99.4%	99.3%	4.55	The system shutdown due to a storm caused power interruption.	The system shutdown, 0340 h on 17 August and restarted at 0813 h.
	MTUs H&I	99.4%	98.8%	4.23	The system shutdown due to a power interruption.	The system shutdown, 0340 h on 17 August and restarted at 0754 h.
September 2010	MTU J	87.1%	99.0%	92.82	Turned off system in preparation of approaching Hurricane Earl. System restart delayed due to computer error.	The system was shutdown at 1304 h on 3 September and restarted at 0953 h on 7 September.
	MTU K	96.4%	99.2%	20.65 5.32	1. Turned off system in preparation of approaching Hurricane Earl. 2. Mechanical maintenance: replaced gasket on Vessel #4.	1. The system was shutdown at 1148 h on 3 September and restarted at 0827 h on 4 September. 2. System was shut down at 0839 on 28 September and restarted 1358 h.
	MTUs H&I	97.2%	98.7%	20.37	Turned off system in preparation of approaching Hurricane Earl.	The system was shutdown at 1245 h on 3 September and restarted at 0907 h on 4 September.
October 2010	MTU J	100.0%	99.1%	0.00	No Downtime	
	MTU K	100.0%	99.2%	0.00	No Downtime	
	MTUs H&I	91.1%	98.4%	43.42	System shutdown to exchange media.	The system was shutdown at 1415 h on 27 October and restarted at 0940 h on 29 October.
November 2010	MTU J	100.0%	99.1%	0.00	No Downtime	
	MTU K	94.0%	99.0%	46.02	System shutdown to exchange and backwash the GAC.	The system shutdown, 1514 h on 17 November restarted at 1315 h on 19 November.
	MTUs H&I	99.6%	98.5%	3.00	System shutdown by high floor sump level switch.	The system shutdown, 1043 h on 13 November restarted at 1343 h.
December 2010	MTU J	100.0%	99.1%	0.00	No Downtime	
	MTU K	82.8%	98.4%	99.4 27.77	1. System was turned off pending acqusition and repair of a safety valve and hose connection. 2. System went down due to a storm related power supply interruption.	1. System shutdown 1500 h on 17 December and restarted 1824 h on 21 December. 2. System down at 0930 h on 27 December and restarted 1016 h 28 December.
	MTUs H&I	100.0%	98.5%	0.00	No Downtime	
January 2011	MTU J	100.0%	99.2%	0.00	No Downtime	
	MTU K	100.0%	98.5%	0.00	No Downtime	
	MTUs H&I	100.0%	98.6%	0.00	No Downtime	
February 2011	MTU J	100.0%	99.2%	0.00	No Downtime	
	MTU K	100.0%	98.6%	0.00	No Downtime	
	MTUs H&I	100.0%	98.6%	0.00	No Downtime	

Table 2-1
Plant Maintenance, Availability, and Downtime Summary

Month	Plant	Availability		Maintenance/Downtime for Period		
		Period	Start-up to Date	Pump Hours	Event	Date/Action
March 2011	**MTU J**	93.9%	99.0%	44.20	System was turned off for a planned carbon changeout.	The system shutdown, 1451 h on 7 March and restarted at 1103 h on 9 March.
	MTU K	100.0%	98.6%	0.00	No Downtime	
	MTUs H&I	100.0%	98.7%	0.00	No Downtime	
April 2011	**MTU J**	90.4%	98.8%	68.38 3.45	1. System shutdown due to power supply interruption, but no alarm sent. 2. System shutdown due to power failure.	1. System down at 1608 h on 22 April and restarted 0931 h on 25 Arpil. 2. Power off at 0554 28 April and system restarted 0921 28 April.
	MTU K	84.0%	98.1%	46.42 0.5 65.15 3.27	1. System was turned off for a planned carbon changeout. 2. System turned off to backwash two GAC units. 3. Groundwater pump fault (VFD undercurrent) shut system down. 4. System power out due to car accident on Rt. 130.	1. System shutdown 14:15 h on 4 April and restarted 1240 h on 6 April. 2. System down at 1328 h on 20 April and restarted 1358 h. 3. Power off at 1607 22 April and system restarted 0916 25 April. 4. Power failure 0553 28 April and system restarted 0909.
	MTUs H&I	89.9%	98.4%	2.0 68.05 3.0	1. System was shutdown by power surge. 2. System shutdown due to power supply interruption, but no alarm sent. 3. System shutdown due to power failure.	1. System shutdown 0707 h on 17 April and restarted 0907 h. 2. System down at 1319 h on 22 April and restarted 0922 h on 25 Arpil. 3. Power off at 0553 28 April and system restarted 0853 28 April.
May 2011	**MTU J**	100.0%	98.8%	0.00	No Downtime	
	MTU K	100.0%	98.2%	0.00	No Downtime	
	MTUs H&I	97.0%	98.3%	22.83	Automatic system shutdown due to apparent high inlet pressure.	The system shutdown 1120 h on 18 May and restarted at 1010 h on 19 May.
June 2011	**MTU J**	100.0%	98.8%	0.00	No Downtime	
	MTU K	96.9%	98.2%	22.50	System shutdown to repair pinhole leak in pipe.	The system shutdown 1100 h on 7 June and restarted at 0930 h on 8 June.
	MTUs H&I	100.0%	98.4%	0.00	No Downtime	
July 2011	**MTU J**	99.9%	98.9%	1.03	The system shutdown due to a storm related power interruption.	The system shutdown 1242 h on 23 July and restarted at 1344 h.
	MTU K	99.9%	98.2%	0.85	The system shutdown due to a power interruption.	The system shutdown 1225 h on 23 July and restarted at 1346 h.
	MTUs H&I	100.0%	98.4%	0.00	No Downtime	

	Cumulative % Available		Pump Hours Down	
	Reporting Period	Since Startup		
Through 31 July 2011 MTU J	97.58%	98.86%	44.2	Downtime During Reporting Period: Planned Shutdowns
			167.45	Downtime During Reporting Period: Unplanned Shutdowns
			211.65	Total Downtime Hours During Reporting Period
			286.95	Total Downtime hours since Startup

Table 2-1
Plant Maintenance, Availability, and Downtime Summary

Month	Plant	Availability		Maintenance/Downtime for Period		
		Period	Start-up to Date	Pump Hours	Event	Date/Action
Through 31 July 2011 MTU K		96.12%	98.21%	90.97	Downtime During Reporting Period: Planned Shutdowns	
				248.41	Downtime During Reporting Period: Unplanned Shutdowns	
				339.38	Total Downtime Hours During Reporting Period	
				451.22	Total Downtime hours since Startup	
Through 31 July 2011 MTU's H&I		97.88%	98.44%	61.97	Downtime During Reporting Period: Planned Shutdowns	
				123.48	Downtime During Reporting Period: Unplanned Shutdowns	
				185.45	Total Downtime Hours During Reporting Period	
				393.48	Total Downtime hours since Startup	

Table 3-1
J-2 Range Eastern GW RRA Unit J
Analytical Results

Date	Time	Location Identifier	Sample Port	Laboratory Analyses			Field Parameters					
				Explosives		Perchlorate (µg/L)	Temp (°C)	SpC (µS/cm)	DO (mg/L)	pH	ORP (mV)	Turbidity (ntu)
				RDX (µg/L)	HMX (µg/L)							
8/10/2010	15:20	J2E-INF	J2E-INF-J-23A	0.345	0.664	0.951	10.49	45	11.72	6.12	99.3	0
8/10/2010	15:25	J2E-MID-1	J2E-MID-1J-23A	NS	NS	ND	10.16	44	10.17	5.96	104.0	0
8/10/2010	15:30	J2E-MID-2	J2E-MID-2J-23A	ND	ND	NS	10.13	44	9.07	6	112.2	0
8/10/2010	15:35	J2E-EFF	J2E-EFF-J-23A	ND	ND	ND	10.37	47	10.57	6.07	120.9	0
9/8/2010	16:25	J2E-INF	J2E-INF-J-24A	ND	0.513	1.17	10.60	45	11.89	6.62	162.0	0
9/8/2010	16:30	J2E-MID-1	J2E-MID-1J-24A	NS	NS	ND	10.32	45	12.28	6.49	169.0	0
9/8/2010	16:35	J2E-MID-2	J2E-MID-2J-24A	ND	ND	NS	10.33	45	11.63	6.35	173.5	0
9/8/2010	16:40	J2E-EFF	J2E-EFF-J-24A	ND	ND	ND	10.55	45	11.5	6.45	172.7	0
10/7/2010	11:30	J2E-INF	J2E-INF-J-25A	0.251	0.549	1.18	10	47	11.66	6.37	171.6	0
10/7/2010	11:35	J2E-MID-1	J2E-MID-1J-25A	NS	NS	ND	9.79	50	11.81	6.34	173.1	0
10/7/2010	11:40	J2E-MID-2	J2E-MID-2J-25A	ND	ND	NS	9.85	52	11.66	6.32	175.2	0
10/7/2010	11:45	J2E-EFF	J2E-EFF-J-25A	ND	ND	ND	9.92	44	11.45	6.39	177.9	0
11/9/2010	10:20	J2E-INF	J2E-INF-J-26A	ND	0.523	1.17	9.73	50	11.71	6.44	151.9	0
11/9/2010	10:25	J2E-MID-1	J2E-MID-1J-26A	NS	NS	ND	9.68	51	11.81	6.35	156.1	0
11/9/2010	10:30	J2E-MID-2	J2E-MID-2J-26A	ND	ND	NS	9.69	51	11.71	6.29	161.1	0
11/9/2010	10:35	J2E-EFF	J2E-EFF-J-26A	ND	ND	ND	9.7	51	11.53	6.37	163.5	0
12/7/2010	10:10	J2E-INF	J2E-INF-J-27A	0.25	0.538	1.27	9.1	47	11.14	6.64	153.3	0
12/7/2010	10:15	J2E-MID-1	J2E-MID-1J-27A	NS	NS	ND	9.44	48	11.73	6.61	144.4	0
12/7/2010	10:20	J2E-MID-2	J2E-MID-2J-27A	ND	ND	NS	9.52	47	11.62	6.62	146.9	0
12/7/2010	10:25	J2E-EFF	J2E-EFF-J-27A	ND	ND	ND	9.34	49	11.53	6.62	155.2	0
1/11/2011	11:00	J2E-INF	J2E-INF-J-28A	ND	0.627	1.29	9.08	53	11.86	6.64	221.9	0
1/11/2011	11:05	J2E-MID-1	J2E-MID-1J-28A	NS	NS	ND	9.52	58	11.8	6.61	224.4	0
1/11/2011	11:10	J2E-MID-2	J2E-MID-2J-28A	ND	ND	NS	9.5	53	11.66	6.62	224.1	0
1/11/2011	11:15	J2E-EFF	J2E-EFF-J-28A	ND	ND	ND	9.48	53	11.55	6.62	226.5	0
2/6/2011	13:40	J2E-INF	J2E-INF-J-29A	0.328	0.632	1.15	9.46	46	11.94	6.14	184.7	0
2/6/2011	13:45	J2E-MID-1	J2E-MID-1J-29A	NS	NS	ND	9.64	46	11.86	6.12	186.0	0
2/6/2011	13:50	J2E-MID-2	J2E-MID-2J-29A	ND	**0.253**	NS	9.65	48	11.79	6.06	188.3	0
2/6/2011	13:55	J2E-EFF	J2E-EFF-J-29A	ND	ND	ND	9.64	48	11.58	6.13	190.4	0
3/10/2011	12:35	J2E-INF	J2E-INF-J-30A	0.313	0.64	1.17	9.5	45	12.74	6.4	324.8	0
3/10/2011	12:40	J2E-MID-1	J2E-MID-1J-30A	NS	NS	ND	9.57	45	12.41	6.23	335.3	0
3/10/2011	12:45	J2E-MID-2	J2E-MID-2J-30A	ND	ND	NS	9.59	45	12.22	6.18	340.4	0
3/10/2011	12:50	J2E-EFF	J2E-EFF-J-30A	ND	ND	ND	9.55	43	11.97	6.5	336.6	0
4/12/2011	10:35	J2E-INF	J2E-INF-J-31A	0.346	0.638	1.15	9.91	58	14.72	6.34	196.7	0
4/12/2011	10:40	J2E-MID-1	J2E-MID-1J-31A	NS	NS	ND	9.77	58	14.93	6.29	198.9	0
4/12/2011	10:45	J2E-MID-2	J2E-MID-2J-31A	ND	ND	NS	9.79	58	14.77	6.26	200.3	0
4/12/2011	10:50	J2E-EFF	J2E-EFF-J-31A	ND	ND	ND	9.78	58	14.34	6.3	205.5	0
5/10/2011	12:25	J2E-INF	J2E-INF-J-32A	0.291	0.459	1.16	9.82	62	12.32	6.2	224.6	0
5/10/2011	12:30	J2E-MID-1	J2E-MID-1J-32A	NS	NS	ND	9.81	62	11.98	6.11	230.4	0
5/10/2011	12:35	J2E-MID-2	J2E-MID-2J-32A	ND	ND	NS	9.81	62	11.67	6.19	232.4	0
5/10/2011	12:40	J2E-EFF	J2E-EFF-J-32A	ND	ND	ND	9.83	62	11.54	6.36	236.7	0
6/7/2011	10:00	J2E-INF	J2E-INF-J-33A	ND	0.579	1.24	10.59	60	11.09	6.19	173.5	0
6/7/2011	10:05	J2E-MID-1	J2E-MID-1J-33A	NS	NS	ND	10.09	60	11.21	6.21	177.5	0
6/7/2011	10:10	J2E-MID-2	J2E-MID-2J-33A	ND	ND	NS	10.09	60	11.03	6.15	184.5	0
6/7/2011	10:15	J2E-EFF	J2E-EFF-J-33A	ND	ND	ND	10.22	60	10,91	6.28	188.2	0
7/12/2011	13:30	J2E-INF	J2E-INF-J-34A	0.299	0.588	1.15	10.15	62	11.7	6.17	116.4	0
7/12/2011	13:35	J2E-MID-1	J2E-MID-1J-34A	NS	NS	ND	10.11	62	11.43	6.18	120.4	0
7/12/2011	13:40	J2E-MID-2	J2E-MID-2J-34A	ND	ND	NS	10.17	62	11.22	6.23	125.0	0
7/12/2011	13:45	J2E-EFF	J2E-EFF-J-34A	ND	ND	ND	10.55	62	10.98	6.28	136.8	0

Legend:

RDX = Hexahydro-1,3,5-Trinitro-1,3,5-Triazine
HMX = Octahydro-1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine
µg/L = micrograms per liter (parts per billion)
ND = <0.25 µg/L for RDX and HMX, and <0.35 µg/L for Perchlorate

NA = not available
NS = not sampled
Breakthrough Detected

Temp = temperature
SpC = specific conductivity
DO = dissolved oxygen
ORP = oxidation reduction potential

°C = degrees Celsius
µS/cm = microsiemens per centimeter
mg/L = milligrams per liter (parts per million)
mV = millivolts
ntu = nephelometric turbidity units

Where duplicate sample results were available, the result presented is the average of the two samples.

Table 3-2
J-2 Range Eastern GW RRA Units H and I
Analytical Results

Date	Time	Location Identifier	Sample Port	Laboratory Analyses: Explosives RDX (µg/L)	Explosives HMX (µg/L)	Perchlorate	Field Parameters: Temp (°C)	SpC (µS/cm)	DO (mg/L)	pH	ORP (mV)	Turb. (ntu)
7/7/2010	10:50	J2E-INF-I	J2E-INF-I-22A	0.88	ND	3.97	10.72	63	11.33	6.83	157.8	0
7/7/2010	10:55	J2E-MID-1I	J2E-MID-1I-22A	NS	NS	ND	10.23	63	11.42	6.71	163.4	0
7/7/2010	11:00	J2E-MID-2I	J2E-MID-2I-22A	ND	ND	NS	10.3	63	11.2	6.59	168.1	0
7/7/2010	11:05	J2E-EFF-I	J2E-EFF-I-22A	C	C	C	10.54	64	11.2	6.67	169.5	0
7/7/2010	11:10	J2E-MID-1H	J2E-MID-1H-22A	NS	NS	ND	10.37	63	11.32	6.57	172.7	0
7/7/2010	11:15	J2E-MID-2H	J2E-MID-2H-22A	ND	ND	NS	10.22	63	11.48	6.58	173	0
7/7/2010	11:20	J2E-EFF-H	J2E-EFF-H-22A	C	C	C	10.33	63	11.4	6.6	173.1	0
7/7/2010		J2E-EFF-IH	J2E-EFF-IH-22A	ND	ND	ND						
8/10/2010	10:40	J2E-INF-I	J2E-INF-I-23A	0.91	0.322	3.69	10.69	58	11.49	6.18	125.8	0
8/10/2010	10:45	J2E-MID-1I	J2E-MID-1I-23A	NS	NS	ND	10.04	57	11.87	6.1	129.3	0
8/10/2010	10:50	J2E-MID-2I	J2E-MID-2I-23A	ND	ND	NS	10.31	57	11.65	6.03	134.9	0
8/10/2010	10:55	J2E-EFF-I	J2E-EFF-I-23A	C	C	C	10.4	57	11.65	6.02	140.2	0
8/10/2010	11:00	J2E-MID-1H	J2E-MID-1H-23A	NS	NS	ND	10.59	57	12.05	6.12	143.9	0
8/10/2010	11:05	J2E-MID-2H	J2E-MID-2H-23A	ND	ND	NS	10.09	57	12.12	6.09	146.4	0
8/10/2010	11:10	J2E-EFF-H	J2E-EFF-H-23A	C	C	C	10.32	57	12.08	6.11	149.7	0
8/10/2010		J2E-EFF-IH	J2E-EFF-IH-23A	ND	ND	ND						
9/8/2010	13:05	J2E-INF-I	J2E-INF-I-24A	0.66	0.261	3.82	10.62	55	11.3	7.1	130.4	0
9/8/2010	13:10	J2E-MID-1I	J2E-MID-1I-24A	NS	NS	ND	10.07	44	11.5	6.94	128.2	0
9/8/2010	13:15	J2E-MID-2I	J2E-MID-2I-24A	ND	ND	NS	10.15	35	11.28	6.8	133.9	0
9/8/2010	13:20	J2E-EFF-I	J2E-EFF-I-24A	C	C	C	10.28	34	10.95	6.66	137.4	0
9/8/2010	13:25	J2E-MID-1H	J2E-MID-1H-24A	NS	NS	ND	10.46	32	11.57	6.67	142.9	0
9/8/2010	13:30	J2E-MID-2H	J2E-MID-2H-24A	ND	ND	NS	10.11	32	11.5	6.65	145.4	0
9/8/2010	13:35	J2E-EFF-H	J2E-EFF-H-24A	C	C	C	10.13	32	11.38	6.61	148.8	0
9/8/2010		J2E-EFF-IH	J2E-EFF-IH-24A	ND	ND	ND						
10/5/2010	13:10	J2E-INF-I	J2E-INF-I-25A	0.79	ND	3.93	10.62	55	11.3	7.1	130.4	0
10/5/2010	13:15	J2E-MID-1I	J2E-MID-1I-25A	NS	NS	ND	10.07	44	11.5	6.94	128.2	0
10/5/2010	13:20	J2E-MID-2I	J2E-MID-2I-25A	ND	ND	NS	10.15	35	11.28	6.8	133.9	0
10/5/2010	13:25	J2E-EFF-I	J2E-EFF-I-25A	C	C	C	10.28	34	10.95	6.66	137.4	0
10/5/2010	13:30	J2E-MID-1H	J2E-MID-1H-25A	NS	NS	ND	10.46	32	11.57	6.67	142.9	0
10/5/2010	13:35	J2E-MID-2H	J2E-MID-2H-25A	**0.250**	ND	NS	10.11	32	11.5	6.65	145.4	0
10/5/2010	13:40	J2E-EFF-H	J2E-EFF-H-25A	C	C	C	10.13	32	11.38	6.61	148.8	0
10/5/2010		J2E-EFF-IH	J2E-EFF-IH-25A	ND	ND	ND						
11/8/2010	11:30	J2E-INF-I	J2E-INF-I-26A	0.83	ND	3.71	9.66	53	11.35	6.49	169.9	0
11/8/2010	11:35	J2E-MID-1I	J2E-MID-1I-26A	NS	NS	ND	9.75	55	11.48	6.44	172.2	0
11/8/2010	11:40	J2E-MID-2I	J2E-MID-2I-26A	ND	ND	NS	9.73	60	11.37	6.41	173.2	0
11/8/2010	11:45	J2E-EFF-I	J2E-EFF-I-26A	C	C	C	9.74	56	11.15	6.43	172.2	0
11/8/2010	11:50	J2E-MID-1H	J2E-MID-1H-26A	NS	NS	ND	9.62	55	11.46	6.5	169.2	0
11/8/2010	11:55	J2E-MID-2H	J2E-MID-2H-26A	ND	ND	NS	9.48	56	11.32	6.54	174.2	0
11/8/2010	12:00	J2E-EFF-H	J2E-EFF-H-26A	C	C	C	9.71	57	11.24	6.51	175	0
11/8/2010		J2E-EFF-IH	J2E-EFF-IH-26A	ND	ND	ND						
12/7/2010	15:40	J2E-INF-I	J2E-INF-I-27A	0.52	ND	3.08	8.85	53	11.69	6.72	170.4	0
12/7/2010	15:45	J2E-MID-1I	J2E-MID-1I-27A	NS	NS	ND	9.6	52	11.45	6.76	166.4	0
12/7/2010	15:50	J2E-MID-2I	J2E-MID-2I-27A	ND	ND	NS	9.51	53	11.49	6.77	166.2	0
12/7/2010	15:55	J2E-EFF-I	J2E-EFF-I-27A	C	C	C	9.53	54	11.19	6.71	167.1	0
12/7/2010	16:00	J2E-MID-1H	J2E-MID-1H-27A	NS	NS	ND	9.37	54	11.54	6.77	178.6	0
12/7/2010	16:05	J2E-MID-2H	J2E-MID-2H-27A	ND	ND	NS	9.12	55	11.47	6.81	175.6	0
12/7/2010	16:10	J2E-EFF-H	J2E-EFF-H-27A	C	C	C	9.41	55	13.56	6.81	173.1	0
12/7/2010		J2E-EFF-IH	J2E-EFF-IH-27A	ND	ND	ND						
1/11/2011	10:05	J2E-INF-I	J2E-INF-I-28A	0.72	0.31	3.23	8.79	55	11.72	7.07	202.3	0
1/11/2011	10:10	J2E-MID-1I	J2E-MID-1I-28A	NS	NS	ND	9.46	50	11.52	6.98	203.6	0
1/11/2011	10:15	J2E-MID-2I	J2E-MID-2I-28A	ND	ND	NS	9.39	56	11.34	6.86	204.4	0
1/11/2011	10:20	J2E-EFF-I	J2E-EFF-I-28A	C	C	C	9.4	51	11.07	6.74	206.7	0
1/11/2011	10:25	J2E-MID-1H	J2E-MID-1H-28A	NS	NS	ND	8.4	55	11.91	6.86	220.3	0
1/11/2011	10:30	J2E-MID-2H	J2E-MID-2H-28A	ND	ND	NS	9.21	56	11.55	6.86	217.7	0
1/11/2011	10:35	J2E-EFF-H	J2E-EFF-H-28A	C	C	C	9.44	56	11.29	6.8	218.4	0
1/11/2011		J2E-EFF-IH	J2E-EFF-IH-28A	ND	ND	ND						
2/6/2011	12:50	J2E-INF-I	J2E-INF-I-29A	0.67	ND	3.11	9.67	50	11.43	6.44	168.4	0
2/6/2011	12:55	J2E-MID-1I	J2E-MID-1I-29A	NS	NS	ND	9.7	50	11.53	6.36	175.6	0
2/6/2011	13:00	J2E-MID-2I	J2E-MID-2I-29A	ND	ND	NS	9.71	49	11.31	6.35	172.3	0
2/6/2011	13:05	J2E-EFF-I	J2E-EFF-I-29A	C	C	C	9.69	55	11.17	6.34	171.4	0
2/6/2011	13:10	J2E-MID-1H	J2E-MID-1H-29A	NS	NS	ND	9.35	50	11.71	6.36	167.6	0

Table 3-2
J-2 Range Eastern GW RRA Units H and I
Analytical Results

Date	Time	Location Identifier	Sample Port	Laboratory Analyses			Field Parameters					
				Explosives		Perchlorate	Temp (°C)	SpC (µS/cm)	DO (mg/L)	pH	ORP (mV)	Turb. (ntu)
				RDX (µg/L)	HMX (µg/L)							
2/6/2011	13:15	J2E-MID-2H	J2E-MID-2H-29A	ND	ND	NS	9.37	47	11.53	6.4	186.6	0
2/6/2011	13:20	J2E-EFF-H	J2E-EFF-H-29A	C	C	C	9.43	50	11.43	6.38	183.5	0
2/6/2011		J2E-EFF-IH	J2E-EFF-IH-29A	ND	ND	ND						
3/8/2011	9:25	J2E-INF-I	J2E-INF-I-30A	0.52	0.283	2.74	9.74	52	11.81	6.44	152	0
3/8/2011	9:30	J2E-MID-1I	J2E-MID-1I-30A	NS	NS	ND	9.74	50	11.88	6.36	157.1	0
3/8/2011	9:35	J2E-MID-2I	J2E-MID-2I-30A	ND	ND	NS	9.75	49	11.6	6.35	154.8	0
3/8/2011	9:40	J2E-EFF-I	J2E-EFF-I-30A	C	C	C	9.71	50	11.51	6.34	155.3	0
3/8/2011	9:45	J2E-MID-1H	J2E-MID-1H-30A	NS	NS	ND	9.61	49	11.82	6.36	160.8	0
3/8/2011	9:50	J2E-MID-2H	J2E-MID-2H-30A	ND	ND	NS	9.7	49	11.73	6.4	159.8	0
3/8/2011	9:55	J2E-EFF-H	J2E-EFF-H-30A	C	C	C	9.64	50	11.55	6.38	162	0
3/8/2011		J2E-EFF-IH	J2E-EFF-IH-30A	ND	ND	ND						
4/11/2011	12:10	J2E-INF-I	J2E-INF-I-31A	0.42	0.648	2.49	9.92	62	11.3	6.48	216.8	0
4/11/2011	12:15	J2E-MID-1I	J2E-MID-1I-31A	NS	NS	ND	9.86	62	11.46	6.45	218.1	0
4/11/2011	12:20	J2E-MID-2I	J2E-MID-2I-31A	ND	ND	NS	9.86	62	11.34	6.44	216.8	0
4/11/2011	12:25	J2E-EFF-I	J2E-EFF-I-31A	C	C	C	9.86	62	11.36	6.45	216.8	0
4/11/2011	12:30	J2E-MID-1H	J2E-MID-1H-31A	NS	NS	ND	9.9	62	11.54	6.44	215.2	0
4/11/2011	12:35	J2E-MID-2H	J2E-MID-2H-31A	ND	ND	NS	9.9	62	11.24	6.48	213.3	0
4/11/2011	12:40	J2E-EFF-H	J2E-EFF-H-31A	C	C	C	9.9	62	11.05	6.45	213.8	0
4/11/2011		J2E-EFF-IH	J2E-EFF-IH-31A	ND	ND	ND						
5/9/2011	14:40	J2E-INF-I	J2E-INF-I-32A	0.30	0.108	2.59	9.99	64	10.94	6.55	191.9	0
5/9/2011	14:45	J2E-MID-1I	J2E-MID-1I-32A	NS	NS	ND	9.91	64	10.98	6.49	202.3	0
5/9/2011	14:50	J2E-MID-2I	J2E-MID-2I-32A	ND	ND	NS	9.91	64	10.79	6.42	213	0
5/9/2011	14:55	J2E-EFF-I	J2E-EFF-I-32A	C	C	C	9.94	64	11.23	6.42	215.3	0
5/9/2011	15:00	J2E-MID-1H	J2E-MID-1H-32A	NS	NS	ND	9.98	64	10.82	6.38	229	0
5/9/2011	15:05	J2E-MID-2H	J2E-MID-2H-32A	ND	ND	NS	9.14	64	10.82	6.49	243.3	0
5/9/2011	15:10	J2E-EFF-H	J2E-EFF-H-32A	C	C	C	9.98	64	10.84	6.49	237.1	0
5/9/2011		J2E-EFF-IH	J2E-EFF-IH-32A	ND	ND	ND						
6/6/2011	11:45	J2E-INF-I	J2E-INF-I-33A	0.56	0.256	2.55	10.25	64	10.93	6.5	180.5	0
6/6/2011	11:50	J2E-MID-1I	J2E-MID-1I-33A	NS	NS	ND	10.05	64	11	6.5	182.6	0
6/6/2011	11:55	J2E-MID-2I	J2E-MID-2I-33A	ND	ND	NS	10	64	11.05	6.5	183.5	0
6/6/2011	12:00	J2E-EFF-I	J2E-EFF-I-33A	C	C	C	10.15	64	10.68	6.44	187.5	0
6/6/2011	12:05	J2E-MID-1H	J2E-MID-1H-33A	NS	NS	ND	10.44	64	10.85	6.4	187.5	0
6/6/2011	12:10	J2E-MID-2H	J2E-MID-2H-33A	ND	ND	NS	10.25	65	10.93	6.46	185.5	0
6/6/2011	12:15	J2E-EFF-H	J2E-EFF-H-33A	C	C	C	10.32	64	10.66	6.52	186.6	0
6/6/2011		J2E-EFF-IH	J2E-EFF-IH-33A	ND	ND	ND						
7/12/2011	10:55	J2E-INF-I	J2E-INF-I-34A	0.53	ND	2.48	10.6	66	10.69	6.55	181.3	0
7/12/2011	11:00	J2E-MID-1I	J2E-MID-1I-34A	NS	NS	ND	10.14	66	11.05	6.57	181.5	0
7/12/2011	11:05	J2E-MID-2I	J2E-MID-2I-34A	ND	ND	NS	10.17	66	10.89	6.52	186.1	0
7/12/2011	11:10	J2E-EFF-I	J2E-EFF-I-34A	C	C	C	10.36	66	10.7	6.49	184.7	0
7/12/2011	11:15	J2E-MID-1H	J2E-MID-1H-34A	NS	NS	ND	10.46	66	11.36	6.71	174.5	0
7/12/2011	11:20	J2E-MID-2H	J2E-MID-2H-34A	ND	ND	NS	10.34	66	10.85	6.61	177.7	0
7/12/2011	11:25	J2E-EFF-H	J2E-EFF-H-34A	C	C	C	10.31	66	10.67	6.53	181.1	0
7/12/2011		J2E-EFF-IH	J2E-EFF-IH-34A	ND	ND	ND						

Legend:

RDX = Hexahydro-1,3,5-Trinitro-1,3,5-Triazine
HMX = Octahydro-1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine
µg/L = micrograms per liter (parts per billion)
ND = <0.25 µg/L for RDX and HMX, and <0.35 µg/L for Perchlorate

NA = not available
NS = not sampled
Breakthrough Detected
C=Composited Samples

Temp = temperature
SpC = specific conductivity
DO = dissolved oxygen
ORP = oxidation reduction potential
Turb = turbidity

°C = degrees Celsius
µS/cm = microsiemens per centimeter
mg/L = milligrams per liter (parts per million)
mV = millivolts
ntu = nephelometric turbidity units

Where duplicate sample results were available, the result presented is the average of the two samples.

Table 3-3
J-2 Range Eastern GW RRA Unit K
Analytical Results

Date	Time	Location Identifier	Sample Port	Laboratory Analyses			Field Parameters					
				Explosives		Perchlorate	Temp (°C)	SpC (µS/cm)	DO (mg/L)	pH	ORP (mV)	Turb. (ntu)
				RDX (µg/L)	HMX (µg/L)							
8/10/2010	14:45	J2E-INF	J2E-INF-K-23A	0.903	ND	0.442	10.84	56	10.96	6.32	99.3	0
8/10/2010	14:50	J2E-MID-1	J2E-MID-1K-23A	NS	NS	ND	10.31	53	11.01	6.33	104.0	0
8/10/2010	14:55	J2E-MID-2	J2E-MID-2K-23A	ND	ND	NS	10.25	53	11.24	6.29	112.2	0
8/10/2010	15:00	J2E-EFF	J2E-EFF-K-23A	ND	ND	ND	10.60	55	11.36	6.36	120.9	0
9/8/2010	15:55	J2E-INF	J2E-INF-K-24A	0.772	ND	0.452	11.10	46	10.77	7.16	165.7	0
9/8/2010	16:00	J2E-MID-1	J2E-MID-1K-24A	NS	NS	ND	10.44	45	11.37	7.09	101.9	0
9/8/2010	16:05	J2E-MID-2	J2E-MID-2K-24A	ND	ND	NS	10.65	45	11.2	7.04	162.7	0
9/8/2010	16:10	J2E-EFF	J2E-EFF-K-24A	ND	ND	ND	10.60	46	11.35	7.02	167.7	0
10/7/2010	10:50	J2E-INF	J2E-INF-K-25A	0.668	ND	0.451	10.18	67	10.89	6.87	136.8	0
10/7/2010	10:55	J2E-MID-1	J2E-MID-1K-25A	NS	NS	ND	9.91	66	11.26	6.88	138.9	0
10/7/2010	11:00	J2E-MID-2	J2E-MID-2K-25A	**0.326**	ND	NS	9.92	62	11.14	6.89	143.6	0
10/7/2010	11:05	J2E-EFF	J2E-EFF-K-25A	ND	ND	ND	9.99	60	11.08	6.89	149.1	0
11/9/2010	9:50	J2E-INF	J2E-INF-K-26A	0.652	ND	0.484	10.18	67	10.89	6.87	136.8	0
11/9/2010	9:55	J2E-MID-1	J2E-MID-1K-26A	NS	NS	ND	9.91	66	11.26	6.88	138.9	0
11/9/2010	10:00	J2E-MID-2	J2E-MID-2K-26A	ND	ND	NS	9.92	62	11.14	6.89	143.6	0
11/9/2010	10:05	J2E-EFF	J2E-EFF-K-26A	ND	ND	ND	9.99	60	11.08	6.89	149.1	0
12/7/2010	8:20	J2E-INF	J2E-INF-K-27A	0.778	ND	0.474	9.26	62	11.17	6.52	144.4	0
12/7/2010	8:25	J2E-MID-1	J2E-MID-1K-27A	NS	NS	ND	9.36	60	11.25	6.6	142.3	0
12/7/2010	8:30	J2E-MID-2	J2E-MID-2K-27A	ND	ND	NS	9.34	60	11.27	6.61	141.4	0
12/7/2010	8:35	J2E-EFF	J2E-EFF-K-27A	ND	ND	ND	9.33	60	11.2	6.5	143.6	0
1/11/2011	9:25	J2E-INF	J2E-INF-K-28A	0.75	ND	0.437	9.02	65	11.22	7.59	167.8	0
1/11/2011	9:30	J2E-MID-1	J2E-MID-1K-28A	NS	NS	ND	9.60	61	11.32	7.26	169.7	0
1/11/2011	9:35	J2E-MID-2	J2E-MID-2K-28A	ND	ND	NS	9.52	66	11.3	7.2	167.7	0
1/11/2011	9:40	J2E-EFF	J2E-EFF-K-28A	ND	ND	ND	9.53	61	11.22	7.12	174.4	0
2/6/2011	12:05	J2E-INF	J2E-INF-K-29A	0.736	ND	0.425	9.61	58	11.23	6.41	170.5	0
2/6/2011	12:10	J2E-MID-1	J2E-MID-1K-29A	NS	NS	ND	9.70	58	11.4	6.48	168.0	0
2/6/2011	12:15	J2E-MID-2	J2E-MID-2K-29A	ND	ND	NS	9.70	58	11.21	6.5	167.7	0
2/6/2011	12:20	J2E-EFF	J2E-EFF-K-29A	ND	ND	ND	9.69	57	11.17	6.52	169.1	0
3/10/2011	11:55	J2E-INF	J2E-INF-K-30A	0.627	ND	0.427	9.69	52	11.78	6.65	317.6	0
3/10/2011	12:00	J2E-MID-1	J2E-MID-1K-30A	NS	NS	ND	9.69	52	12.09	6.72	316.0	0
3/10/2011	12:05	J2E-MID-2	J2E-MID-2K-30A	**0.254**	ND	NS	9.71	52	11.88	6.73	316.9	0
3/10/2011	12:10	J2E-EFF	J2E-EFF-K-30A	ND	ND	ND	9.70	52	11.67	6.73	319.4	0
4/12/2011	10:10	J2E-INF	J2E-INF-K-31A	0.591	ND	0.416	10.26	68	11.78	6.78	193.0	0
4/12/2011	10:15	J2E-MID-1	J2E-MID-1K-31A	NS	NS	ND	9.95	67	12.09	6.8	192.7	0
4/12/2011	10:20	J2E-MID-2	J2E-MID-2K-31A	ND	ND	NS	10.00	67	11.88	6.77	193.8	0
4/12/2011	10:25	J2E-EFF	J2E-EFF-K-31A	ND	ND	ND	9.97	68	11.67	6.77	195.2	0
5/10/2011	11:45	J2E-INF	J2E-INF-K-32A	0.612	ND	0.408	10.18	76	10.78	6.74	197.0	0
5/10/2011	11:50	J2E-MID-1	J2E-MID-1K-32A	NS	NS	ND	9.95	73	11.11	6.83	202.5	0
5/10/2011	11:55	J2E-MID-2	J2E-MID-2K-32A	ND	ND	NS	9.90	72	10.96	6.76	208.5	0
5/10/2011	12:00	J2E-EFF	J2E-EFF-K-32A	ND	ND	ND	9.90	73	11.05	6.76	213.7	0
6/7/2011	9:35	J2E-INF	J2E-INF-K-33A	0.759	ND	0.408	10.85	72	11.94	6.77	185.5	0
6/7/2011	9:40	J2E-MID-1	J2E-MID-1K-33A	NS	NS	ND	10.48	70	10.49	6.74	185.9	0
6/7/2011	9:45	J2E-MID-2	J2E-MID-2K-33A	ND	ND	NS	10.26	69	10.47	6.74	192.4	0
6/7/2011	9:50	J2E-EFF	J2E-EFF-K-33A	ND	ND	ND	10.37	70	10.33	6.74	194.3	0
7/12/2011	10:30	J2E-INF	J2E-INF-K-34A	0.637	ND	0.414	10.62	72	10.49	6.88	178.0	0
7/12/2011	10:35	J2E-MID-1	J2E-MID-1K-34A	NS	NS	ND	10.22	72	10.72	6.86	181.0	0
7/12/2011	10:40	J2E-MID-2	J2E-MID-2K-34A	ND	ND	NS	10.15	72	10.62	6.81	182.9	0
7/12/2011	10:45	J2E-EFF	J2E-EFF-K-34A	ND	ND	ND	10.31	72	10.59	6.82	189.6	0

Legend:

RDX = Hexahydro-1,3,5-Trinitro-1,3,5-Triazine
HMX = Octahydro-1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine
µg/L = micrograms per liter (parts per billion)
ND = <0.25 µg/L for RDX and HMX, and <0.35 µg/L for Perchlorate

NA = not available
NS = not sampled
Breakthrough Detected

Temp = temperature
SpC = specific conductivity
DO = dissolved oxygen
ORP = oxidation reduction potential
Turb = turbidity

°C = degrees Celsius
µS/cm = microsiemens per centimeter
mg/L = milligrams per liter (parts per million)
mV = millivolts
ntu = nephelometric turbidity units

Where duplicate sample results were available, the result presented is the average of the two samples.

Table 3-4
J2 Range Eastern
Plant/System Production Summary

Plant/System	Design Flow Rate (gpm)	Average Flow Rate for Period (gpm)		Total Extracted Volume Treated (gallons)		Total Contaminant Mass Removal (pounds)					
						Perchlorate		RDX		HMX	
		Aug 10 thru July 11	Since Startup	Aug 10 thru July 11	Since Startup	Aug 10 thru July 11	Since Startup	Aug 10 thru July 11	Since Startup	Aug 10 thru July 11	Since Startup
MTUs H&I	210	206	208	107,780,790	314,837,550	2.81	7.88	0.56	1.93	0.24	0.65
MTU J	90	87	89	45,828,010	133,721,430	0.45	1.32	0.11	0.41	0.22	1.06
MTU K	125	120	122	62,658,780	185,326,740	0.23	0.71	0.37	0.95	0.00	0.00
TOTAL	425	413	420	216,267,580	633,885,720	3.49	9.92	1.04	3.29	0.46	1.71

Table 3-5
J2 Range Eastern RRA System Sampling Locations and Parameters for Operational Monitoring

Parameter	System Influent	MID-1 Post IX	MID-2 Post Lead GAC	System Effluent (Post Guard GAC)
Contaminants of Concern				
Perchlorate	monthly	monthly	None, until a detect at Post IX	monthly
Explosives	monthly	None	monthly	monthly
Geochemistry				
Metals, Modified; Hardness	TBD	TBD	TBD	TBD
Chloride; Sulfate; Alkalinity	TBD	TBD	TBD	TBD
Ammonia; Nitrate/Nitrite; Phosphorus	TBD	TBD	TBD	TBD
Total Organic Carbon	TBD	TBD	TBD	TBD
Total Suspended Solids (TSS)	TBD	TBD	TBD	TBD
Field Measurements				
Dissolved Oxygen	X	X	X	X
pH	X	X	X	X
Specific Conductivity	X	X	X	X
Temperature	X	X	X	X
Oxygen Reduction Potential	X	X	X	X
Turbidity	X	X	X	X

Notes:

1. X = Field measurements will be taken concurrent with all sampling events
2. TBD = To be determined: i.e., when necessary to evaluate system operations if system appears to be underperforming
3. Sampling locations, parameters and frequency will be continuously evaluated and any proposed changes will be submitted for review and approval prior to implementation

Table 4-1
J-2 Range Eastern Plume Water Level Monitoring Network

Location	Northing (UTM - meters)	Easting (UTM - meters)	Ground Elevation (msl)	Screen Top Elevation (msl ft)	Screen Bottom Elevation (msl ft)
J2MW-01M1	4618356.62	374761.25	175.68	-99.32	-109.32
J2MW-01M2	4618357.86	374760.40	175.65	-69.35	-79.35
J2MW-01PZ	4618356.73	374761.35	175.68	-9.32	-19.32
J2MW-02M1	4618333.91	374792.08	175.36	-95.64	-105.64
J2MW-02M2	4618333.84	374792.03	175.36	-60.64	-70.64
J2MW-02PZ	4618333.90	374792.01	175.36	-15.64	-25.64
J2MW-03M1	4618785.71	375004.29	162.49	-107.51	-117.51
J2MW-03M2	4618785.64	375004.33	162.49	-59.42	-69.42
J2MW-03PZ	4618785.60	375004.36	162.49	-17.51	-27.51
J2MW-04M1	4618594.98	374925.94	157.30	-99.70	-109.70
J2MW-04M2	4618594.95	374925.82	157.30	-52.70	-62.70
J2MW-05M1	4618111.09	374432.51	167.08	-57.92	-67.92
J2MW-05M2	4618111.12	374432.42	167.08	-17.92	-27.92
MW-128M1	4617499.58	373486.54	157.74	13.74	3.74
MW-128M2	4617498.97	373486.52	157.74	53.74	43.74
MW-128S	4617499.27	373486.84	157.74	70.74	60.74
MW-170M1	4618618.11	374574.77	175.13	-89.87	-99.87
MW-170M2	4618618.02	374574.59	175.13	-22.87	-32.87
MW-170M3	4618618.11	374574.86	175.13	52.13	42.13
MW-215M1	4618041.02	374701.82	171.88	-68.12	-78.12
MW-215M2	4618041.14	374701.97	171.88	-33.12	-43.12
MW-307M2	4617869.83	374063.94	172.86	-58.60	-68.60
MW-307M3	4617869.88	374063.94	172.86	47.06	37.04
MW-321M1	4617936.94	374264.08	173.38	-1.62	-11.62
MW-321M2	4617936.99	374264.08	173.38	-30.62	-40.62
MW-324M1	4618275.68	374840.08	174.08	-60.77	-70.77
MW-324M2	4618275.73	374840.08	174.08	-29.66	-40.66
MW-335M1	4618476.24	374680.98	177.52	-47.68	-87.68
MW-335M2	4618476.29	374680.98	177.52	-37.73	-47.73
MW-335M3	4618476.34	374680.98	177.52	57.65	47.65
MW-339M1	4618319.25	374443.03	168.84	-64.16	-74.16
MW-339M2	4618319.30	374443.03	168.84	-44.16	-54.16
MW-351M1	4618926.80	374912.64	159.83	-118.81	-128.81
MW-351M2	4618926.85	374912.64	159.83	-73.84	-83.84
MW-354M1	4618674.05	375115.62	175.02	-99.98	-109.98
MW-354M2	4618674.10	375115.62	175.02	-59.98	-69.98
MW-365M1	4618130.69	375057.48	156.16	-119.32	-129.32
MW-365M2	4618130.74	375057.48	156.16	-49.36	-59.36
MW-365S	4618130.79	375057.48	156.16	63.30	53.30
MW-366M1	4618464.87	374321.37	153.13	-61.87	-71.87
MW-366M2	4618464.92	374321.37	153.13	-21.87	-31.87
MW-366M3	4618464.97	374321.37	153.13	8.13	-1.87
MW-368M1	4618192.81	374619.14	171.20	-65.80	-75.80
MW-368M2	4618192.78	374619.23	171.20	-31.80	-41.80
MW-368M3	4618192.92	374619.22	171.20	15.70	5.70
MW-381M1	4618712.55	374499.33	178.22	-54.72	-55.72
MW-381M2	4618712.60	374499.33	178.22	-18.17	-28.17
MW-388M1	4618221.26	374192.92	140.91	-34.09	-44.09
MW-388M2	4618221.31	374192.92	140.91	-4.09	-14.09
MW-393D	4618805.31	374983.69	156.51	-157.49	-167.49
MW-393M1	4618805.36	374983.69	156.51	-111.56	-121.56
MW-393M2	4618805.41	374983.69	156.51	-61.65	-71.65
MW-436M1	4619279.38	375181.85	177.01	-118.46	-128.46
MW-436M2	4619279.43	375181.85	177.01	-58.44	-68.44

Table 4-2
J-2 Range Eastern Plume Water Level Results and Analysis

Monitoring Well Geometries				Prior to System Startup Groundwater Elevations	2009 - 2010 Groundwater Elevations		2010 - 2011 Groundwater Elevations		2009/10 to 2010/11 Water Level Changes	
Location	Ground Elevation (msl)	Screen Top Elevation (msl ft)	Screen Bottom Elevation (msl ft)	9/2/2008 (msl)	9/1/2009 (msl)	3/3/2010 (msl)	9/13/2010 (msl)	3/14/2011 (msl)	Change 9/1/09 to 9/13/10	Change 3/3/10 to 3/14/11
J2MW-01M1	175.68	(99.32)	(109.32)	70.10	68.80	70.04	73.24	70.66	4.44	0.62
J2MW-01M2	175.65	(69.35)	(79.35)	69.99	68.28	69.57	72.74	70.20	4.46	0.63
J2MW-01PZ	175.68	(9.32)	(19.32)	69.97	(7.88)	(9.02)	(8.50)	71.03	(0.62)	80.05
J2MW-02M1	175.36	(95.64)	(105.64)	69.94	68.98	70.25	73.39	70.88	4.41	0.63
J2MW-02M2	175.36	(60.64)	(70.64)	70.01	68.99	70.23	73.37	70.86	4.38	0.63
J2MW-02PZ	175.36	(15.64)	(25.64)	69.92	69.40	70.68	73.80	71.28	4.40	0.60
J2MW-03M1	162.49	(107.51)	(117.51)	68.86	68.16	69.51	72.67	70.27	4.51	0.76
J2MW-03M2	162.49	(59.42)	(69.42)	68.88	68.46	69.79	72.93	70.54	4.47	0.75
J2MW-03PZ	162.49	(17.51)	(27.51)	68.77	68.61	69.99	73.13	70.76	4.52	0.77
J2MW-04M1	157.30	(99.70)	(109.70)	**Not Measured**	69.34	70.62	73.79	71.34	4.45	0.72
J2MW-04M2	157.30	(52.70)	(62.70)	69.48	69.30	70.62	73.79	71.35	4.49	0.73
J2MW-05M1	167.08	(57.92)	(67.92)	70.69	70.40	71.61	74.84	72.29	4.44	0.68
J2MW-05M2	167.08	(17.92)	(27.92)	70.78	70.01	71.24	74.46	71.90	4.45	0.66
MW-128M1	157.74	13.74	3.74	71.13	71.30	72.57	75.59	73.32	4.29	0.75
MW-128M2	157.74	53.74	43.74	71.13	71.32	72.65	75.60	73.34	4.28	0.69
MW-128S	157.74	70.74	60.74	71.14	71.34	72.58	75.59	73.31	4.25	0.73
MW-170M1	175.13	(89.87)	(99.87)	69.60	69.51	70.84	74.12	71.59	4.61	0.75
MW-170M2	175.13	(22.87)	(32.87)	69.75	69.86	71.17	74.51	71.96	4.65	0.79
MW-170M3	175.13	52.13	42.13	69.82	69.93	71.19	75.51	72.01	5.58	0.82
MW-215M1	171.88	(68.12)	(78.12)	70.18	70.05	71.31	74.33	71.89	4.28	0.58
MW-215M2	171.88	(33.12)	(43.12)	70.26	70.17	71.46	74.44	72.01	4.27	0.55
MW-307M2	172.86	(58.60)	(68.60)	70.92	70.89	72.17	75.35	72.78	4.46	0.61
MW-307M3	172.86	47.06	37.04	70.92	70.88	72.15	75.34	72.78	4.46	0.63
MW-321M1	173.38	(1.62)	(11.62)	70.73	70.57	71.84	74.97	72.46	4.40	0.62
MW-321M2	173.38	(30.62)	(40.62)	70.78	70.59	71.84	74.99	72.45	4.40	0.61
MW-324M1	174.08	(60.77)	(70.77)	69.92	69.64	70.92	73.99	71.52	4.35	0.60
MW-324M2	174.08	(29.66)	(40.66)	69.96	69.75	71.02	74.10	71.60	4.35	0.58
MW-335M1	177.52	(47.68)	(87.68)	70.01	69.73	70.99	74.27	71.71	4.54	0.72
MW-335M2	177.52	(37.73)	(47.73)	69.99	69.84	71.10	74.40	71.83	4.56	0.73
MW-335M3	177.52	57.65	47.65	69.99	69.84	71.12	74.38	71.82	4.54	0.70
MW-339M1	168.84	(64.16)	(74.16)	70.49	70.27	71.50	74.84	72.23	4.57	0.73
MW-339M2	168.84	(44.16)	(54.16)	70.55	70.32	71.55	74.89	72.29	4.57	0.74
MW-351M1	159.83	(118.81)	(128.81)	68.53	68.35	69.72	72.96	70.57	4.61	0.85
MW-351M2	159.83	(73.84)	(83.84)	68.52	68.38	69.73	72.99	70.59	4.61	0.86
MW-354M1	175.02	(99.98)	(109.98)	68.89	68.80	70.16	73.22	70.81	4.42	0.65
MW-354M2	175.02	(59.98)	(69.98)	68.92	68.83	70.21	73.27	70.86	4.44	0.65
MW-365M1	156.16	(119.32)	(129.32)	69.33	69.45	70.76	73.56	71.21	4.11	0.45
MW-365M2	156.16	(49.36)	(59.36)	70.01	70.15	71.46	74.25	71.91	4.10	0.45
MW-365S	156.16	63.30	53.30	69.88	70.22	71.59	74.37	72.03	4.15	0.44
MW-366M1	153.13	(61.87)	(71.87)	70.15	70.14	71.32	74.84	72.16	4.70	0.84
MW-366M2	153.13	(21.87)	(31.87)	70.23	70.22	71.43	74.93	72.25	4.71	0.82
MW-366M3	153.13	8.13	(1.87)	70.25	70.25	71.44	74.95	72.27	4.70	0.83
MW-368M1	171.20	(65.80)	(75.80)	69.79	69.45	70.70	73.85	71.34	4.40	0.64
MW-368M2	171.20	(31.80)	(41.80)	69.91	69.63	70.87	74.03	71.48	4.40	0.61
MW-368M3	171.20	15.70	5.70	69.85	70.11	71.36	74.52	71.95	4.41	0.59
MW-381M1	178.22	(54.72)	(55.72)	69.62	69.71	70.98	74.46	71.82	4.75	0.84

Table 4-2
J-2 Range Eastern Plume Water Level Results and Analysis

Monitoring Well Geometries				Prior to System Startup Groundwater Elevations	2009 - 2010 Groundwater Elevations		2010 - 2011 Groundwater Elevations		2009/10 to 2010/11 Water Level Changes	
Location	Ground Elevation (msl)	Screen Top Elevation (msl ft)	Screen Bottom Elevation (msl ft)	9/2/2008 (msl)	9/1/2009 (msl)	3/3/2010 (msl)	9/13/2010 (msl)	3/14/2011 (msl)	Change 9/1/09 to 9/13/10	Change 3/3/10 to 3/14/11
MW-381M2	178.22	(18.17)	(28.17)	69.84	70.30	71.35	74.81	72.20	4.51	0.85
MW-388M1	140.91	(34.09)	(44.09)	70.58	70.54	71.76	75.19	72.51	4.65	0.75
MW-388M2	140.91	(4.09)	(14.09)	70.66	70.57	71.79	75.20	72.54	4.63	0.75
MW-393D	156.51	(157.49)	(167.49)	68.70	68.34	69.69	72.89	70.50	4.55	0.81
MW-393M1	156.51	(111.56)	(121.56)	68.78	68.36	69.71	72.88	70.50	4.52	0.79
MW-393M2	156.51	(61.65)	(71.65)	68.76	68.54	69.87	73.05	70.67	4.51	0.80
MW-436M1	177.01	(118.46)	(128.46)	67.09	67.01	68.43	71.52	69.33	4.51	0.90
MW-436M2	177.01	(58.44)	(68.44)	67.09	67.00	68.42	71.50	69.34	4.50	0.92

Yellow highlight - Erroneous values not used in evaluation.

Bold - Wells with representative screens used for groundwater surface contouring.

Table 4-3
J-2 Range Eastern Plume Water Level Results and Vertical Gradients

Monitoring Well Elevations				2006 Ambient Conditions		2010 Groundwater Elevations			
Location	Top of Casing Elevation (ft msl)	Screen Top Elevation (ft msl)	Screen Bottom Elevation (ft msl)	9/2/2008 (msl)	Vertical Gradient	9/13/2010 (ft msl)	Vertical Gradient	3/14/2011 (ft msl)	Vertical Gradient
J2MW-01M2	175.65	(69.35)	(79.35)	69.99		72.74	+0.0167	70.20	
J2MW-01M1	175.68	(99.32)	(109.32)	70.10	+0.0036	73.24	+0.0167	70.66	+0.0153
J2MW-02PZ	175.36	(15.64)	(25.64)	69.92		73.80		71.28	
J2MW-02M2	175.36	(60.64)	(70.64)	70.01	+0.0020	73.37	-0.0096	70.86	-0.0093
J2MW-02M1	175.36	(95.64)	(105.64)	69.94	-0.0019	73.39	+0.0006	70.88	+0.0006
J2MW-03PZ	162.49	(17.51)	(27.51)	68.77		73.13		70.76	
J2MW-03M2	162.49	(59.42)	(69.42)	68.88	+0.0027	72.93	-0.0048	70.54	-0.0052
J2MW-03M1	162.49	(107.51)	(117.51)	68.86	-0.0006	72.67	-0.0054	70.27	-0.0056
J2MW-04M2	157.30	(52.70)	(62.70)	69.48		73.79		71.35	
J2MW-04M1	157.30	(99.70)	(109.70)	NA	NA	73.79	+0.0000	71.34	-0.0002
J2MW-05M2	167.08	(17.92)	(27.92)	70.78		74.46		71.90	
J2MW-05M1	167.08	(57.92)	(67.92)	70.69	-0.0022	74.84	+0.0095	72.29	+0.0098
MW-128M1	157.74	13.74	3.74	71.13		75.59		73.32	
MW-128M2	157.74	53.74	43.74	71.13	+0.0000	75.60	-0.0002	73.34	-0.0005
MW-128S	157.74	70.74	60.74	71.14	-0.0006	75.59	+0.0006	73.31	+0.0018
MW-170M3	175.13	52.13	42.13	69.82		75.51		72.01	
MW-170M2	175.13	(22.87)	(32.87)	69.75	-0.0010	74.51	-0.0133	71.96	-0.0007
MW-170M1	175.13	(89.87)	(99.87)	69.60	-0.0022	74.12	-0.0058	71.59	-0.0055
MW-215M2	171.88	(33.12)	(43.12)	70.26		74.44		72.01	
MW-215M1	171.88	(68.12)	(78.12)	70.18	-0.0023	74.33	-0.0031	71.89	-0.0034
MW-307M3	172.86	47.06	37.04	70.92		75.34		72.78	
MW-307M2	172.86	(58.60)	(68.60)	70.92	+0.0000	75.35	+0.0001	72.78	+0.0000
MW-321M1	173.38	(1.62)	(11.62)	70.73		74.97		72.46	
MW-321M2	173.38	(30.62)	(40.62)	70.78	+0.0016	74.99	+0.0007	72.45	-0.0003
MW-324M2	174.08	(29.66)	(40.66)	69.96		74.10		71.60	
MW-324M1	174.08	(60.77)	(70.77)	69.92	-0.0013	73.99	-0.0036	71.52	-0.0026
MW-335M3	177.52	57.65	47.65	69.99		74.38		71.82	
MW-335M2	177.52	(37.73)	(47.73)	69.99	-0.0000	74.40	+0.0002	71.83	+0.0001
MW-335M1	177.52	(47.68)	(87.68)	70.01	+0.0009	74.27	-0.0052	71.71	-0.0048
MW-339M2	168.84	(44.16)	(54.16)	70.55		74.89		72.29	
MW-339M1	168.84	(64.16)	(74.16)	70.49	-0.0027	74.84	-0.0025	72.23	-0.0030
MW-351M2	159.83	(73.84)	(83.84)	68.52		72.99		70.59	
MW-351M1	159.83	(118.81)	(128.81)	68.53	+0.0003	72.96	-0.0007	70.57	-0.0004
MW-354M2	175.02	(59.98)	(69.98)	68.92		73.27		70.86	
MW-354M1	175.02	(99.98)	(109.98)	68.89	-0.0007	73.22	-0.0012	70.81	-0.0012
MW-365S	156.16	63.30	53.30	69.88		74.37		72.03	
MW-365M2	156.16	(49.36)	(59.36)	70.01	+0.0012	74.25	-0.0011	71.91	-0.0011
MW-365M1	156.16	(119.32)	(129.32)	69.33	-0.0097	73.56	-0.0099	71.21	-0.0100
MW-366M3	153.13	8.13	(1.87)	70.25		74.95		72.27	
MW-366M2	153.13	(21.87)	(31.87)	70.23	-0.0007	74.93	-0.0007	72.25	-0.0007
MW-366M1	153.13	(61.87)	(71.87)	70.15	-0.0020	74.84	-0.0023	72.16	-0.0023
MW-368M3	171.20	15.70	5.70	69.85		74.52		71.95	
MW-368M2	171.20	(31.80)	(41.80)	69.91	+0.0014	74.03	-0.0103	71.48	-0.0099
MW-368M1	171.20	(65.80)	(75.80)	69.79	-0.0037	73.85	-0.0053	71.34	-0.0041
MW-381M2	178.22	(18.17)	(28.17)	69.84		74.81		72.20	
MW-381M1	178.22	(54.72)	(55.72)	69.62	-0.0069	74.46	-0.0109	71.82	-0.0119
MW-388M2	140.91	(4.09)	(14.09)	70.66		75.20		72.54	
MW-388M1	140.91	(34.09)	(44.09)	70.58	-0.0027	75.19	-0.0003	72.51	-0.0010
MW-393M2	156.51	(61.65)	(71.65)	68.76		73.05		70.67	
MW-393M1	156.51	(111.56)	(121.56)	68.78	+0.0004	72.88	-0.0034	70.50	-0.0034
MW-393D	156.51	(157.49)	(167.49)	68.70	-0.0017	72.89	+0.0002	70.50	+0.0000
MW-436M2	177.01	(58.44)	(68.44)	67.09		71.50		69.34	
MW-436M1	177.01	(118.46)	(128.46)	67.09	+0.0000	71.52	+0.0003	69.33	-0.0002

Notes:
ft - feet
msl - mean sea level (equivalent to zero elevation NGVD29)
NA - data not available
positive gradient denotes upward flow
negative gradient denotes downward flow

Table 5-1
J-2 Eastern Plume Monitoring Well Sampling Results

Location	Sample Type	Analyte	Short Name	Test Method	Reported Result (ug/L)	Qualifier	Reporting Limit (ug/L)	Top of Screen (msl)	Bottom of Screen (msl)	Log Date
J2MW-01M1	N1	ND for 1 Analytes	Perchlorate	SW6860	ND	U	ND	-99.88	-109.88	09/15/2010
J2MW-01M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-99.88	-109.88	09/15/2010
J2MW-01M2	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	3.0		0.22	-69.61	-79.61	09/15/2010
J2MW-01M2	N1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	-69.61	-79.61	09/15/2010
J2MW-01M2	N1	Perchlorate	PCATE	SW6860	29.4		0.50	-69.61	-79.61	09/15/2010
J2MW-01M2	FD1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	3.5		0.22	-69.61	-79.61	09/15/2010
J2MW-01M2	FD1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	-69.61	-79.61	09/15/2010
J2MW-01M2	FD1	Perchlorate	PCATE	SW6860	30.7		0.50	-69.61	-79.61	09/15/2010
J2MW-04M1	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	1.7		0.21	-100.07	-110.07	03/17/2011
J2MW-04M1	N1	ND for 17 Analytes	Explosives	SW8330	ND	U	ND	-100.07	-110.07	03/17/2011
J2MW-04M1	N1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	0.79		0.21	-100.07	-110.07	03/17/2011
J2MW-04M1	N1	Perchlorate	PCATE	SW6860	1.9		0.050	-100.07	-110.07	03/17/2011
J2MW-04M1	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	2.6		0.21	-100.07	-110.07	10/05/2010
J2MW-04M1	N1	ND for 17 Analytes	Explosives	SW8330	ND	U	ND	-100.07	-110.07	10/05/2010
J2MW-04M1	N1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	0.35		0.21	-100.07	-110.07	10/05/2010
J2MW-04M1	N1	Perchlorate	PCATE	SW6860	3.1		0.050	-100.07	-110.07	10/05/2010
J2MW-04M1	FD1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	2.6		0.21	-100.07	-110.07	10/05/2010
J2MW-04M1	FD1	ND for 17 Analytes	Explosives	SW8330	ND	U	ND	-100.07	-110.07	10/05/2010
J2MW-04M1	FD1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	0.34		0.21	-100.07	-110.07	10/05/2010
J2MW-04M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-53.06	-63.06	03/17/2011
J2MW-04M2	N1	Perchlorate	PCATE	SW6860	0.056		0.050	-53.06	-63.06	03/17/2011
J2MW-04M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-53.06	-63.06	10/05/2010
J2MW-04M2	N1	Perchlorate	PCATE	SW6860	0.13		0.050	-53.06	-63.06	10/05/2010
J2MW-05M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-58.15	-68.15	10/05/2010
J2MW-05M1	N1	Perchlorate	PCATE	SW6860	0.16		0.050	-58.15	-68.15	10/05/2010
J2MW-05M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-18.16	-28.16	10/05/2010
J2MW-05M2	N1	Perchlorate	PCATE	SW6860	0.22		0.050	-18.16	-28.16	10/05/2010
MW-116S	N1	Perchlorate	PCATE	SW6860	0.26		0.050	70.33	60.33	09/14/2010
MW-170M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-90.41	-100.41	09/14/2010
MW-170M1	N1	Perchlorate	PCATE	SW6860	0.10		0.050	-90.41	-100.41	09/14/2010
MW-170M2	N1	ND for 1 Analytes	Perchlorate	SW6850	ND	U	ND	-23.4	-33.4	05/19/2011
MW-170M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-23.4	-33.4	05/19/2011
MW-170M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-23.4	-33.4	09/14/2010
MW-170M2	N1	Perchlorate	PCATE	SW6860	0.021	J	0.050	-23.4	-33.4	09/14/2010
MW-215M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-68.63	-78.63	09/29/2010
MW-215M1	N1	Perchlorate	PCATE	SW6860	0.23		0.050	-68.63	-78.63	09/29/2010
MW-215M1	LR1	Perchlorate	PCATE	SW6860	0.23		0.050	-68.63	-78.63	09/29/2010
MW-215M2	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	2.1		0.21	-33.62	-43.62	09/29/2010
MW-215M2	N1	ND for 17 Analytes	Explosives	SW8330	ND	U	ND	-33.62	-43.62	09/29/2010
MW-215M2	N1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	3.1		0.21	-33.62	-43.62	09/29/2010
MW-215M2	N1	Perchlorate	PCATE	SW6860	4.0		0.050	-33.62	-43.62	09/29/2010
MW-228M2	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	0.83		0.22	45.81	35.81	09/15/2010
MW-228M2	N1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	45.81	35.81	09/15/2010
MW-228M2	N1	Perchlorate	PCATE	SW6860	0.073		0.050	45.81	35.81	09/15/2010
MW-228S	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	67.8	57.8	03/17/2011
MW-228S	N1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	67.8	57.8	09/15/2010
MW-228S	N1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	0.34	J	0.22	67.8	57.8	09/15/2010
MW-228S	FD1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	67.8	57.8	09/15/2010

Table 5-1
J-2 Eastern Plume Monitoring Well Sampling Results

Location	Sample Type	Analyte	Short Name	Test Method	Reported Result (ug/L)	Qualifier	Reporting Limit (ug/L)	Top of Screen (msl)	Bottom of Screen (msl)	Log Date
MW-228S	FD1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	0.22	J	0.21	67.8	57.8	09/15/2010
MW-307M3	N1	ND for 19 Analytes	Explosives	SW8330	ND	UJ	ND	46.37	36.37	03/17/2011
MW-307M3	N1	Perchlorate	PCATE	SW6860	2.1		0.050	46.37	36.37	03/17/2011
MW-307M3	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	46.17	36.17	09/14/2010
MW-307M3	N1	Perchlorate	PCATE	SW6860	2.9		0.050	46.17	36.17	09/14/2010
MW-310M1	N1	Perchlorate	PCATE	SW6860	1.6		0.050	-19.42	-29.42	03/14/2011
MW-310M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-19.02	-29.02	09/14/2010
MW-310M1	N1	Perchlorate	PCATE	SW6860	2.8		0.050	-19.02	-29.02	09/14/2010
MW-310M1	FD1	Perchlorate	PCATE	SW6860	2.8		0.050	-19.02	-29.02	09/14/2010
MW-319M1	N1	Perchlorate	PCATE	SW6860	0.49		0.050	-39.83	-49.83	03/15/2011
MW-319M1	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	0.15	J	0.21	-39.53	-49.53	09/29/2010
MW-319M1	N1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	-39.53	-49.53	09/29/2010
MW-319M1	N1	Perchlorate	PCATE	SW6860	0.60		0.050	-39.53	-49.53	09/29/2010
MW-319M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-4.48	-14.48	09/29/2010
MW-319M2	N1	Perchlorate	PCATE	SW6860	1.7		0.050	-4.48	-14.48	09/29/2010
MW-321M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-2.3	-12.3	09/16/2010
MW-321M1	N1	Perchlorate	PCATE	SW6860	0.46		0.050	-2.3	-12.3	09/16/2010
MW-321M2	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	0.52		0.21	16.72	6.72	09/16/2010
MW-321M2	N1	ND for 17 Analytes	Explosives	SW8330	ND	U	ND	16.72	6.72	09/16/2010
MW-321M2	N1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	5.3		0.21	16.72	6.72	09/16/2010
MW-321M2	N1	Perchlorate	PCATE	SW6860	0.086		0.050	16.72	6.72	09/16/2010
MW-321M2	FD1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	0.53		0.22	16.72	6.72	09/16/2010
MW-321M2	FD1	ND for 17 Analytes	Explosives	SW8330	ND	U	ND	16.72	6.72	09/16/2010
MW-321M2	FD1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	5.0		0.22	16.72	6.72	09/16/2010
MW-324M1	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	1.1	J	0.20	-61.42	-71.42	03/16/2011
MW-324M1	N1	ND for 17 Analytes	Explosives	SW8330	ND	UJ	ND	-61.42	-71.42	03/16/2011
MW-324M1	N1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	0.23	J	0.20	-61.42	-71.42	03/16/2011
MW-324M1	N1	Perchlorate	PCATE	SW6860	1.4		0.050	-61.42	-71.42	03/16/2011
MW-324M1	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	0.97		0.23	-61.52	-71.52	09/15/2010
MW-324M1	N1	ND for 17 Analytes	Explosives	SW8330	ND	U	ND	-61.52	-71.52	09/15/2010
MW-324M1	N1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	0.54		0.23	-61.52	-71.52	09/15/2010
MW-324M1	N1	Perchlorate	PCATE	SW6860	0.72		0.050	-61.52	-71.52	09/15/2010
MW-324M2	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	1.2		0.22	-30.2	-41.2	03/16/2011
MW-324M2	N1	ND for 17 Analytes	Explosives	SW8330	ND	U	ND	-30.2	-41.2	03/16/2011
MW-324M2	N1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	0.47		0.22	-30.2	-41.2	03/16/2011
MW-324M2	N1	Perchlorate	PCATE	SW6860	1.8		0.050	-30.2	-41.2	03/16/2011
MW-324M2	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	0.78		0.21	-30.5	-40.5	09/15/2010
MW-324M2	N1	ND for 17 Analytes	Explosives	SW8330	ND	U	ND	-30.5	-40.5	09/15/2010
MW-324M2	N1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	0.52		0.21	-30.5	-40.5	09/15/2010
MW-324M2	N1	Perchlorate	PCATE	SW6860	1.6		0.050	-30.5	-40.5	09/15/2010
MW-334M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-113.22	-123.22	09/30/2010
MW-334M1	N1	Perchlorate	PCATE	SW6860	0.23		0.050	-113.22	-123.22	09/30/2010
MW-335M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-78.61	-88.61	03/15/2011
MW-335M1	N1	Perchlorate	PCATE	SW6860	0.59		0.050	-78.61	-88.61	03/15/2011
MW-335M1	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	0.22	J	0.23	-78.41	-88.41	09/14/2010
MW-335M1	N1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	-78.41	-88.41	09/14/2010
MW-335M1	N1	Perchlorate	PCATE	SW6860	4.8		0.050	-78.41	-88.41	09/14/2010
MW-335M1	FD1	Perchlorate	PCATE	SW6860	4.7		0.050	-78.41	-88.41	09/14/2010

Table 5-1
J-2 Eastern Plume Monitoring Well Sampling Results

Location	Sample Type	Analyte	Short Name	Test Method	Reported Result (ug/L)	Qualifier	Reporting Limit (ug/L)	Top of Screen (msl)	Bottom of Screen (msl)	Log Date
MW-335M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-38.72	-48.72	03/15/2011
MW-335M2	N1	Perchlorate	PCATE	SW6860	0.23		0.050	-38.72	-48.72	03/15/2011
MW-335M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-38.42	-48.42	09/14/2010
MW-335M2	N1	Perchlorate	PCATE	SW6860	0.098		0.050	-38.42	-48.42	09/14/2010
MW-339M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-65.08	-75.08	03/15/2011
MW-339M1	N1	Perchlorate	PCATE	SW6860	0.86		0.050	-65.08	-75.08	03/15/2011
MW-339M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-65.08	-75.08	09/29/2010
MW-339M1	N1	Perchlorate	PCATE	SW6860	1.0		0.050	-65.08	-75.08	09/29/2010
MW-339M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-45.06	-55.06	09/29/2010
MW-339M2	N1	Perchlorate	PCATE	SW6860	1.1		0.050	-45.06	-55.06	09/29/2010
MW-342M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-44.93	-54.93	10/04/2010
MW-342M1	N1	Perchlorate	PCATE	SW6860	0.049	J	0.050	-44.93	-54.93	10/04/2010
MW-351M1	N1	Perchlorate	PCATE	SW6860	0.19		0.050	-118.93	-128.93	03/16/2011
MW-351M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-119.33	-129.33	10/04/2010
MW-351M1	N1	Perchlorate	PCATE	SW6860	0.25		0.050	-119.33	-129.33	10/04/2010
MW-351M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-74.05	-84.05	03/16/2011
MW-351M2	N1	Perchlorate	PCATE	SW6860	0.064		0.050	-74.05	-84.05	03/16/2011
MW-351M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-74.35	-84.35	10/04/2010
MW-351M2	N1	Perchlorate	PCATE	SW6860	0.11		0.050	-74.35	-84.35	10/04/2010
MW-354M1	N1	Perchlorate	PCATE	SW6860	0.12		0.050	-99.99	-109.99	03/15/2011
MW-354M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-100.49	-110.49	09/30/2010
MW-354M1	N1	Perchlorate	PCATE	SW6860	0.12		0.050	-100.49	-110.49	09/30/2010
MW-354M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-60.24	-70.24	03/15/2011
MW-354M2	N1	Perchlorate	PCATE	SW6860	0.046	J	0.050	-60.24	-70.24	03/15/2011
MW-354M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-60.44	-70.44	09/30/2010
MW-354M2	N1	Perchlorate	PCATE	SW6860	0.062		0.050	-60.44	-70.44	09/30/2010
MW-355M1	N1	Perchlorate	PCATE	SW6860	0.10		0.050	-62.81	-72.81	10/07/2010
MW-357M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-108.04	-118.04	09/16/2010
MW-357M1	N1	Perchlorate	PCATE	SW6860	0.16		0.050	-108.04	-118.04	09/16/2010
MW-358M1	N1	Perchlorate	PCATE	SW6860	0.095		0.050	-68.67	-78.67	10/05/2010
MW-362M1	N1	Perchlorate	PCATE	SW6860	0.019	J	0.050	-71.09	-81.09	10/07/2010
MW-365M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-49.95	-59.95	09/29/2010
MW-365M2	N1	Perchlorate	PCATE	SW6860	0.078		0.050	-49.95	-59.95	09/29/2010
MW-366M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-62.84	-72.84	09/30/2010
MW-366M1	N1	Perchlorate	PCATE	SW6860	1.0		0.050	-62.84	-72.84	09/30/2010
MW-366M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-22.86	-32.86	09/30/2010
MW-366M2	N1	Perchlorate	PCATE	SW6860	0.38		0.050	-22.86	-32.86	09/30/2010
MW-366M3	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	7.11	-2.89	09/30/2010
MW-366M3	N1	Perchlorate	PCATE	SW6860	0.043	J	0.050	7.11	-2.89	09/30/2010
MW-368M1	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	1.2		0.21	-66.29	-76.29	09/02/2010
MW-368M1	N1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	-66.29	-76.29	09/02/2010
MW-368M1	N1	Perchlorate	PCATE	SW6860	63.1		5.0	-66.29	-76.29	09/02/2010
MW-368M1	FD1	Perchlorate	PCATE	SW6860	69.9		5.0	-66.29	-76.29	09/02/2010
MW-368M2	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	14.6		1.1	-31.97	-41.97	03/15/2011
MW-368M2	N1	ND for 17 Analytes	Explosives	SW8330	ND	U	ND	-31.97	-41.97	03/15/2011
MW-368M2	N1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	0.78	J	0.22	-31.97	-41.97	03/15/2011

Table 5-1
J-2 Eastern Plume Monitoring Well Sampling Results

Location	Sample Type	Analyte	Short Name	Test Method	Reported Result (ug/L)	Qualifier	Reporting Limit (ug/L)	Top of Screen (msl)	Bottom of Screen (msl)	Log Date
MW-368M2	N1	Perchlorate	PCATE	SW6860	54.8		0.50	-31.97	-41.97	03/15/2011
MW-368M2	FD1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	12.8		1.1	-31.97	-41.97	03/15/2011
MW-368M2	FD1	ND for 17 Analytes	Explosives	SW8330	ND	U	ND	-31.97	-41.97	03/15/2011
MW-368M2	FD1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	0.54	J	0.22	-31.97	-41.97	03/15/2011
MW-368M2	FD1	Perchlorate	PCATE	SW6860	54.4		0.50	-31.97	-41.97	03/15/2011
MW-368M2	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	12.1		1.0	-32.27	-42.27	09/02/2010
MW-368M2	N1	ND for 17 Analytes	Explosives	SW8330	ND	U	ND	-32.27	-42.27	09/02/2010
MW-368M2	N1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	0.74		0.21	-32.27	-42.27	09/02/2010
MW-368M2	N1	Perchlorate	PCATE	SW6860	45.6		5.0	-32.27	-42.27	09/02/2010
MW-368M2	FD1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	12.2		1.0	-32.27	-42.27	09/02/2010
MW-368M2	FD1	ND for 17 Analytes	Explosives	SW8330	ND	U	ND	-32.27	-42.27	09/02/2010
MW-368M2	FD1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	0.71		0.20	-32.27	-42.27	09/02/2010
MW-368M2	FD1	Perchlorate	PCATE	SW6860	43.5		5.0	-32.27	-42.27	09/02/2010
MW-368M3	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	15.73	5.73	09/14/2010
MW-368M3	N1	Perchlorate	PCATE	SW6860	0.031	J	0.050	15.73	5.73	09/14/2010
MW-372M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-100.21	-110.21	09/16/2010
MW-372M1	N1	Perchlorate	PCATE	SW6860	0.028	J	0.050	-100.21	-110.21	09/16/2010
MW-381M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-55.21	-65.21	09/15/2010
MW-381M1	N1	Perchlorate	PCATE	SW6860	0.058		0.050	-55.21	-65.21	09/15/2010
MW-381M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-18.14	-28.14	09/15/2010
MW-381M2	N1	Perchlorate	PCATE	SW6860	0.012	J	0.050	-18.14	-28.14	09/15/2010
MW-388M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-34.13	-44.13	09/15/2010
MW-388M1	N1	Perchlorate	PCATE	SW6860	0.078		0.050	-34.13	-44.13	09/15/2010
MW-388M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-4.11	-14.11	09/15/2010
MW-388M2	N1	Perchlorate	PCATE	SW6860	0.68		0.050	-4.11	-14.11	09/15/2010
MW-393D	N1	ND for 1 Analytes	Perchlorate	SW6860	ND	U	ND	-157.96	-167.96	10/04/2010
MW-393M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-111.9	-121.9	10/04/2010
MW-393M1	N1	Perchlorate	PCATE	SW6860	0.12		0.050	-111.9	-121.9	10/04/2010
MW-393M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-61.92	-71.92	10/04/2010
MW-393M2	N1	Perchlorate	PCATE	SW6860	0.025	J	0.050	-61.92	-71.92	10/04/2010
MW-399M1	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	0.21		0.21	-73.86	-83.86	09/14/2010
MW-399M1	N1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	-73.86	-83.86	09/14/2010
MW-399M1	N1	Perchlorate	PCATE	SW6860	0.073		0.050	-73.86	-83.86	09/14/2010
MW-436M1	N1	Perchlorate	PCATE	SW6860	0.10		0.050	-118.5	-128.5	03/16/2011
MW-436M1	N1	Perchlorate	PCATE	SW6860	0.040	J	0.050	-118.5	-128.5	10/05/2010
MW-436M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-58.5	-68.5	03/16/2011
MW-436M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-58	-68	10/05/2010
MW-57D	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-56.51	-66.51	09/30/2010
MW-57D	N1	Perchlorate	PCATE	SW6860	0.23		0.050	-56.51	-66.51	09/30/2010

N = Normal Sample
FD1 = Field Duplicate
ND = Not Detected

U = Non-Detect
J = Estimated

Table 6-1:
J-2 Range Eastern Plume Measured and Predicted Perchlorate Concentrations

Name	Perchlorate (µg/L) Measured	Perchlorate (µg/L) Predicted	Deviation (Predicted/Measured)
J2MW-01M2	29.40	11.17	**38%**
J2MW-04M1	3.10	1.93	**62%**
J2MW-04M2	0.13	0.09	N/A
J2MW-05M1	0.16	0.08	N/A
J2MW-05M2	0.22	2.81	N/A
MW-116S	0.26	0.00	N/A
MW-170M1	0.10	0.03	N/A
MW-170M2*	0.02	0.01	N/A
MW-215M1	0.23	0.22	N/A
MW-215M2	4.00	2.82	**70%**
MW-228M2	0.07	0.09	N/A
MW-307M3	2.90	3.60	**124%**
MW-310M1	2.80	2.30	**82%**
MW-319M1	0.60	0.70	N/A
MW-319M2	1.70	0.35	N/A
MW-321M1	0.46	0.83	N/A
MW-321M2	0.09	0.25	N/A
MW-324M1	1.40	0.20	N/A
MW-324M2	1.80	0.04	N/A
MW-334M1	0.23	0.07	N/A
MW-335M1	4.80	0.51	**11%**
MW-335M2	0.23	0.01	N/A
MW-339M1	1.00	3.55	N/A
MW-339M2	1.10	0.57	N/A
MW-342M1	0.05	0.00	N/A
MW-351M1	0.25	0.12	N/A
MW-351M2	0.11	0.00	N/A
MW-354M1	0.12	0.03	N/A
MW-354M2	0.06	0.00	N/A
MW-355M1	0.10	0.00	N/A
MW-357M1	0.16	0.00	N/A
MW-358M1	0.10	0.00	N/A
MW-362M1	0.02	0.00	N/A
MW-365M2	0.08	0.02	N/A
MW-366M1	1.00	0.49	N/A
MW-366M2	0.38	0.33	N/A
MW-366M3	0.04	0.05	N/A
MW-368M1	63.10	33.54	**53%**
MW-368M2	54.80	18.10	**33%**
MW-368M3	0.03	0.00	N/A
MW-372M1	0.03	0.00	N/A
MW-381M1	0.06	0.03	N/A
MW-381M2	0.01	0.00	N/A
MW-388M1	0.08	0.03	N/A
MW-388M2	0.68	0.35	N/A
MW-393D	0.00	0.02	N/A
MW-393M1	0.12	0.57	N/A
MW-393M2	0.03	0.00	N/A
MW-399M1	0.07	0.00	N/A
MW-436M1	0.10	0.21	N/A
MW-57D	0.23	0.00	N/A

Notes:
N/A - measured concentration less than 2 µg/L and comparison not made.
Red is under-predicted and green is over-predicted.

Table 6-2:
J-2 Range Eastern Plume Measured and Predicted RDX Concentrations

Name	RDX (µg/L)		Deviation
	Measured	Predicted	(Predicted/Measured)
J2MW-01M1	0.00	0.20	N/A
J2MW-01M2	3.00	0.20	**7%**
J2MW-04M1	2.60	0.20	**8%**
J2MW-04M2	0.00	0.29	N/A
J2MW-05M1	0.00	0.29	N/A
J2MW-05M2	0.00	0.20	N/A
MW-170M1	0.00	0.20	N/A
MW-170M2*	0.00	0.20	N/A
MW-215M1	0.00	0.20	N/A
MW-215M2	2.10	0.20	**9%**
MW-228M2	0.83	0.29	**35%**
MW-228S	0.00	0.30	N/A
MW-307M3	0.00	0.29	N/A
MW-310M1	0.00	0.29	N/A
MW-319M1	0.15	0.23	N/A
MW-319M2	0.00	0.20	N/A
MW-321M1	0.00	0.20	N/A
MW-321M2	0.52	0.29	N/A
MW-324M1	1.10	0.20	**18%**
MW-324M2	1.20	0.29	**24%**
MW-334M1	0.00	0.20	N/A
MW-335M1	0.22	0.20	N/A
MW-335M2	0.00	0.29	N/A
MW-339M1	0.00	0.20	N/A
MW-339M2	0.00	0.20	N/A
MW-342M1	0.00	0.20	N/A
MW-351M1	0.00	0.20	N/A
MW-351M2	0.00	0.20	N/A
MW-354M1	0.00	0.20	N/A
MW-354M2	0.00	0.20	N/A
MW-357M1	0.00	0.29	N/A
MW-365M2	0.00	0.31	N/A
MW-366M1	0.00	0.33	N/A
MW-366M2	0.00	0.20	N/A
MW-366M3	0.00	0.29	N/A
MW-368M1	1.20	0.17	**15%**
MW-368M2	14.60	0.20	**1%**
MW-368M3	0.00	0.29	N/A
MW-372M1	0.00	0.20	N/A
MW-381M1	0.00	0.34	N/A
MW-381M2	0.00	0.29	N/A
MW-388M1	0.00	0.20	N/A
MW-388M2	0.00	0.20	N/A
MW-393M1	0.00	0.29	N/A
MW-393M2	0.00	0.29	N/A
MW-399M1	0.21	0.29	N/A
MW-436M2	0.00	0.20	N/A
MW-57D	0.00	0.20	N/A

Notes:
N/A - measured concentration less than 0.6 µg/L and comparison not made.
Red is under-predicted and green is over-predicted.

APPENDIX A

Impact Area Groundwater Study Program
Responses to US Environmental Protection Agency Protection Comments on the Draft J-2 Range Eastern and Northern Interim Environmental Monitoring Reports
August 2010 through July 2011
Dated: December 2011

EPA REVIEW OF RESPONSE TO COMMENTS ON DRAFT J-2 RANGE EASTERN INTERIM ENVIRONMENTAL MONITORING REPORT (DATED APRIL 26, 2012)

GENERAL COMMENTS

1) Please update the plume shell using data through 2011 and after addressing these comments.

Response: The goal of the annual report is to document current conditions in light of historic trends and to make recommendations necessary to optimize the system. The recommendation of whether or not to develop an updated plume shell is considered to be a result of the evaluation and not part of the annual report. The comparison between the measured and predicted J2 Eastern plume remain in reasonable agreement using the existing perchlorate and RDX plume shells. Therefore, the J2 Eastern plume shells are not recommended for updating at this point; however, the need for plume shell updates will continue to be evaluated during the development of future annual reports.

Additional Comment: EPA does not concur that the existing plume shells remain in reasonable agreement with the measured concentrations and believes that a recommendation of this monitoring report should be to update the eastern plume shells using all currently available data. Please edit the report accordingly. Given that the Army is in the process of completing the Feasibility Study for the J-2 Range plumes, now is an appropriate time to update the plume shells and to confirm the viability of the hydraulic modeling and contaminant transport before a remedy is selected for the site. Therefore, EPA reiterates the comments made on these topics in its original comment submittal for the 2010-2011 monitoring report. Subsequently, for future monitoring reports and to facilitate future decision-making, predicted and actual contaminant concentrations should be presented in tabular form for each well screen to demonstrate the continued validity of the transport model. Please note that the PME plan states that chemical data will be evaluated periodically and the evaluations will include identification of contaminant trends upgradient and downgradient of the extraction wells, and remapping of plume geometry and mass distribution (reassessment of plume isocontours).

Resolution: A recommendation will be added to the J-2 Range Eastern annual report to update the perchlorate and RDX plume shells.

SPECIFIC COMMENTS

7) Pg 4-1, §4.2 - The Final J-2 Range Eastern System Performance Monitoring Plan (page 5.3) specifies that "potentiometric maps for the aquifer at selected depth intervals will be constructed and compared against model predictions to ensure that observed performance is within the range of conditions during the design simulation testing." Only one potentiometric map for a single interval between +8.74 feet and -124.38 feet msl was prepared for each monitoring event and presented as Figures 4-2 and 4-3. The depth interval over which the screens of the wells used for developing these potentiometric surfaces is large (133.12 feet). Generally, there appears to be several wells within this interval at each cluster available for use in developing the potentiometric surface. Although water level data from either the M1 or M2 wells within a cluster are generally used for contouring, the basis for selecting a particular well at a specific location is unclear. Frequently, the water levels measured within a cluster varying sufficiently to impact the contouring of the potentiometric surface. Under such conditions, the development of multiple potentiometric surfaces may provide the most reliable means for evaluating the hydraulic response of the aquifer to the extraction system. Potentiometric levels for more discrete intervals should be prepared and used to evaluate the hydraulic performance to the extraction system.

Response: The evaluation in the annual report includes water levels from depths selected to represent the approximate location of the perchlorate plume. The following sentence will be added following the fourth sentence in the third paragraph of Section 4.2: "The well screens selected for use in the development of a potentiometric surface generally coincide with elevations of the perchlorate and RDX plumes".

In addition, there is no comparison between observed water levels and those predicted by the model. Without this comparison, it is not possible to evaluate and confirm the ability of the model to accurately represent the hydraulic system under current conditions. Please provide a comparison between predicted and observed water levels during the current monitoring period. This comparison should include a tabular presentation of predicted and observed water levels at each of the monitoring wells where water levels are collected. In addition, depictions of predicted and observed potentiometric surfaces should be provided for comparison. Any significant differences between predicted and observed water levels should be identified and the potential impact of residual errors on the model reliability evaluated. Comparisons of predicted and observed water levels at multiple depths should be included in this evaluation.

Response: The flow model, being used to support the perchlorate and RDX simulations, represents "average" flow field conditions based on historic data and simulated during the development of the RI/FS for the J2 Range. The only change to the flow model that is made from year-to-year is an update of the well file so that the pumping stress applied to the model is accurate. Therefore, it is expected that from one year to the next the flow model will either over or under predict measured conditions but in the long term the coupled flow and transport model will provide reliable predictions of perchlorate and RDX, provided that the plume shell is regularly updated to reflect the measured conditions. Therefore, discrepancies between measured and predicted water levels are expected and a well-by-well comparison of measured and predicted water levels will not add significant value and are not recommended.

Additional Comment: The monitoring report should be revised to include the language suggested in the response. The approach being followed to depict potentiometric contours based on a single water level elevation within the plume will generally provide a suitable depiction of potentiometric contours for evaluating capture in those areas where limited vertical gradients exist. While this appears to generally be the case within the main portion of the J-2 Range eastern plume, there is an area upgradient of J2EW0005 where the plume has migrated both above and below a silt layer (see Figure 5-2). The water-level data indicate potentially significantly different water level elevations in this area (MW-368M1/M2). In lieu of preparing separate potentiometric maps, the

text should discuss the impact of these differences in water level elevations relative to the depiction of potentiometric contours and the capture of the plume in this area. The text should discuss the development of the potentiometric map and an evaluation of plume capture in any other area where significant vertical gradients exist.

The response also indicates that the model is only intended to predict average hydraulic conditions. The response also further indicates that discrepancies between measured and predicted water levels during any specific monitoring event are expected. However, the model is being used during each monitoring event to evaluate capture and to project the migration of contaminants during each individual monitoring event. Such evaluations and predictions can only be deemed reliable for any specific time period if the model is demonstrated to be a reliable representation of hydraulic behavior and contaminant migration. Before the Feasibility Study is completed, the IAGWSP needs to demonstrate that the hydraulic model for the site is still accurate. In order to demonstrate that, the IAGWSP will need to compare the model predictions and measured values for the site water level data with appropriate adjustments for baseline conditions. Deviations of the modeled water levels from the expected water level ranges should be minimized by recalibrating the model if necessary. Please edit the report to recommend that the hydraulic modeling be verified and calibrated as necessary prior to completing the Feasibility Study.

Resolution: The text will be updated by adding the following sentences to Section 4.2: “The flow model, being used to support the perchlorate and RDX simulations, represents “average” flow field conditions based on historic data and simulated during the development of the RI/FS for the J2 Range. The only change to the flow model that is made from year-to-year is an update of the well file so that the pumping stress applied to the model is accurate. Therefore, it is expected that from one year to the next the flow model will either over or under predict measured conditions but in the long term the coupled flow and transport model will provide reliable predictions of perchlorate and RDX, provided that the plume shell is appropriately updated to reflect the measured conditions. Therefore, discrepancies between measured and predicted water levels are expected and a well-by-well comparison of measured and predicted water levels will not add significant value”.

See response to Specific Comment #12. Significant gradients do not exist anywhere around the site with the exception of in the immediate vicinity of the extraction wells, primarily because of the relatively low rate of groundwater extraction in this very productive aquifer, which is why the model is being primarily used to determine capture zones for evaluation.

A recommendation will be made to re-evaluate and re-calibrate the flow model during the development of the RI/FS for the J-2 Range.

8) Pg 4-1, §4.2 - The Final J-2 Range Eastern System Performance Monitoring Plan (page 5.3) specifies that “long-term (hydraulic) monitoring measurements will be compiled as hydrographs and analyzed for trends in water level changes.” However, no hydrographs have been included in the Interim Environmental Monitoring Report. Please include in the monitoring report a set of hydrographs for monitoring locations and depths that are representative of the changes in groundwater levels observed throughout the site.

    Response: The long term trends in water levels agreed to in the J-2 Eastern System Performance Monitoring Plan has been understood to refer to regional water levels at groundwater level monitoring stations maintained by the USGS. A description of the regional water level trends is provided in paragraph 2 of Section 4.3. Hydrographs were created for the five wells used to evaluate long term water level trends and were used to develop the description provided in Section 4.3. The water level data for the five wells can be found at the following web addresses, which will be included in Section 4.3:

- http://waterdata.usgs.gov/nwis/dv/?site_no=414124070311401&agency_cd=USGS&referred_module=gw
- http://waterdata.usgs.gov/nwis/dv/?site_no=414139070311501&agency_cd=USGS&referred_module=gw
- http://waterdata.usgs.gov/nwis/dv/?site_no=414159070310501&agency_cd=USGS&referred_module=gw
- http://waterdata.usgs.gov/nwis/dv/?site_no=414219070313601&agency_cd=USGS&referred_module=gw

Additional Comment: Links were provided for only four wells not five as stated; however, it appears that there are only four appropriate USGS wells in Barnstable County. If a fifth well was also used please identify it. Please include the relevant USGS water level data in an appendix to the monitoring report and in that appendix discuss in appropriate detail how the comparison was made between the regional water level changes and the site water level changes and the significance of any differences. Also, it would be helpful if a figure were provided which illustrates the location of each of the USGS wells. EPA notes that all four USGS wells are located on the opposite side of the groundwater mound from the J-2 plumes in an area with multiple ponds; therefore, it is not clear that these USGS wells are representative of J-2 Range groundwater fluctuations.

Resolution: There are only four wells that have been used to monitor long term water levels, not five. Therefore, “five” will be changed to “four”. In addition, the following text will be added to Section 4.3: “The four USGS wells provide a detailed history of groundwater levels near the top of the regional groundwater mound. The USGS wells are superior to using J-2 Range monitoring wells because of their long data history and frequency of data collection (every 15 minutes), while water level data at the J-2 Range wells are collected just a few times per year”

9) Pg 4-2, §4.2 - Comparison of the potentiometric contours depicted in Figures 4-2 and 4-3 with the specific water level measurements identified on these figures indicates that there may be an error in contouring. In Figure 4-3, the measured water level at J2MW-04M1 is shown to be 71.34 ft. However, the 70.8 foot contour is drawn immediately adjacent to this well. With a contour interval of 0.2 feet, the 70.8 foot contour appears to be significantly misplaced at this location. The potentiometric contouring in this area of the site should be reexamined and re-contoured as appropriate.

Response: There water level at well J2MW-04M1 was not used in the data contouring and should not have been bolded in the figure. This will be corrected by un-bolding the well name J2MW-04M1 in Figure 4-3.

Additional Comment: It is irrelevant whether or not Army used J2MW-04M1 for contouring water levels; the fact is that the water level at this well is inconsistent with the contours provided indicating that the flow field is not correct. Review of both current and prior water level data for both J2MW-04M1 and M2 indicate that the levels and changes are consistent with the water levels and changes for other wells so that the water levels at J2MW-04M1 and M2 are not anomalous. It appears that the contours connecting J2EW0006 and J2EW0005 are incorrect and should be redrawn, possibly independent of one another. Adequate justification for omitting these data from the development of the potentiometric map should be provided, or the contours should be redrawn to adequately reflect these data.

Resolution: The water level at J2MW-04M1 should have been used in the initial contouring and will

be added back to the dataset so that the groundwater contours can be contoured correctly.

10) Pg 4-1, §4.2 - The monitoring report concludes that "overall, the flow field analysis indicates that gradients are generally in the direction of the extraction wells at the plume elevation." However, examination of the potentiometric surfaces presented in Figures 4-2 and 4-3 indicates that there may be a significant area of bypass immediately to the east and south of monitoring well cluster MW-215. The discussion of the flow field analysis should be revised to acknowledge this potential concern.

Response: The potential problem will be recognized by adding the following sentence immediately prior to the last sentence in the fourth paragraph of Section 4.2: "The only exception to the flow of contaminated groundwater being toward the extraction wells is in the area of well MW-215 where elevated groundwater levels suggest flow toward the northeast".

Additional Comment: Please provide and explanation for this observation and predicted outcomes.

Resolution: The following sentence will be added prior to the last sentence in the last paragraph of Section 4.2: "Groundwater level contours in the area of well MW-215 are a reflection of drawdown at the J2EW0004 extraction well and even though the plume southeast of this well is not anticipated to be captured, groundwater modeling indicates that it will attenuate to a perchlorate concentration of less than 2 µg/L by 2015." The affect of the elevated groundwater level on contaminant transport will be further evaluated in the RI/FS for the J-2 Range"

12) Pg 4-2, §4.4 - The Final J-2 Range Eastern System Performance Monitoring Plan (page 5.3) specifies that "vertical gradients will be tabulated" and that "changes in vertical gradients in well clusters will be evaluated." The environmental monitoring report does not include a tabulation of vertical gradients at each well cluster, nor does it include an evaluation of changes in vertical gradients. The report merely states that "the vertical gradient analysis indicated in the 2009 annual report is assumed to continue to represent the vertical flow component of groundwater flow during the current evaluation period." Adequate justification is not provided for this assumption. Given the recent regional changes in water levels, the tabulation and evaluation of vertical gradients specified in the System Performance and Evaluation Plan should be provided in the current monitoring report. Any deviations from the conceptual model or simulated range of performance should be identified and evaluated for their impact on system performance.

Response: A tabular summary of calculated vertical gradients will be developed and described and both the text and table will be added to Section 4.2 of the report.

The evaluation of vertical gradients and capture zones in the vertical direction would also be facilitated by the preparation of cross-sections similar to those presented for contaminant concentrations in the monitoring report, but with measured water levels identified for each monitoring well rather than contaminant concentration. The preparation of such cross section is recommended.

Response: All of the water level data is presented in the potentiometric maps and throughout the report and reworking the same data into additional data tables and figures is not necessary to evaluate vertical differences in piezometric heads.

Additional Comment: Please provide the proposed text discussing this data for review.

Resolution: The following text will be added to Section 4.4:
"Water levels among the well clusters were used to calculate the vertical gradients within the J-2 Eastern monitoring network. The table presents vertical gradients within the J-2 Eastern plume monitoring network. The Table presents the vertical gradients for the two semi-annual synoptic

events obtained during the reporting period and includes baseline (non-pumping) and operational conditions. The results indicate that the extraction wells have had the desired effect on the aquifer system. The hydraulic gradient changes at the near-field wells (J2MW05M1, M2, J2MW-02M1, M2, PZ, J2MW-01M1, M2, MW-393D, M1, M2, J2MW-03M2, and PZ) showed either reverse or enhanced flow in the direction of the extraction well screens in response to pumping. The hydraulic gradients exhibited at wells farther from the extraction wells did not change significantly between the ambient and the operational condition. The vertical gradient analysis for the site-wide monitoring network only provides very limited insight into the system performance, partly because of the highly conductive nature of the aquifer system and the significantly aquifer thickness relative to the pumping interval."

14) Pg 5-2, Section § 5.1.1, par 5 – It is indicated that concentrations detected at J2MW-05M2 are indicative of continued vertical thinning of the plume. EPA notes that concentrations may continue to be detected from this monitoring well because it is located within the capture zone of J2EW0004.

Response: Noted.

Additional Comment: The EPA's observation regarding the contaminant concentration detected at J2MW-05M2 resulting from the wells location within the capture of J2EW0004 has been noted in the response. However, it would be helpful to include this potential explanation for the contaminant concentrations detected at J2MW-05M2 in the text of the current and future annual monitoring reports.

Resolution: The following sentence will be added to Section 5.1.1:
"Perchlorate concentrations may continue to be detected at J2MW-05M2 because this monitoring well is located within the capture zone of J2EW0004"

15) Pg 6-1, §6.1 - A comparison of model predicted and perchlorate concentration observed during the winter 2011 monitoring event is presented in Figure 6-1. A similar comparison of model predicted and RDX concentrations is provided in Figure 6-2. However, due to the rather broad concentration ranges used in these figures, particularly for perchlorate, it is very difficult to compare the actual and predicted contaminant concentration values based on the information presented in these figures. Moreover, the concentration contours (outlines) presented in the depiction of observed conditions appears to be based on projected historical data as well as current measurements. These figures also are one-dimensional and do not depict the predicted and observed vertical distribution of contaminants.

To facilitate the comparison of predicted and observed contaminant concentrations, the actual predicted concentration at each monitoring well should be shown on the depiction of predicted conditions. Similarly, the actual observed concentration at each monitoring well should be shown on the depiction of observed conditions. In addition, please provide tables presenting predicted and measured perchlorate and RDX concentration values at each monitoring well where contaminant concentrations are measured. The enhanced figures and additional tables will facilitate the comparison of predicted and observed values of contaminant concentrations and allow for a more thorough evaluation of the reliability of the transport model and the continued suitability of the current plume shells. The adequacy of the model and current plume shell should be reevaluated using the enhanced figures and additional tables.

Response: The point-by-point comparison of measured and predicted concentrations is not believed to be a valuable or reliable evaluation of the J2 model's predictive ability as a whole. It is clear that based on a cursory overview of the figures that there are several locations where measured and predicted concentrations would be in disagreement for a variety of reasons including, but not limited to, a flow model that is representative of average rather than actual conditions, and a relatively limited number of data points, with plumes developed by projecting

measurements forward rather than having actual measurements. The annual report is meant to present the measured and predicted plumes to provide for an evaluation of the general shape and magnitude of concentrations and a point-by-point comparison is believed to be outside the scope of an annual report. The contour levels shown in Figures 6-1 and 6-2 are believed to adequately represent the predictive capacity of the model and no changes will be made.

Additional Comment: The comment acknowledges that there are already several locations where the observed and model predicted contaminant concentrations are in disagreement. This is in spite of the response to General Comment No. 1 which states that the comparison between the measured and predicted J2 Eastern plume remains in reasonable agreement using the existing perchlorate and RDX shells. In reality, it is very difficult to determine the extent of the agreement between predicted and observed contaminant concentrations without a direct comparison of predicted and observed contaminant concentrations at each sampling location. The development and presentation of a simple table providing the predicted and observed perchlorate and RDX concentrations at each monitoring location and depth should be a relatively easy matter. Such a tabular display would greatly facilitate the evaluation of the extent of agreement between model predictions and observed contaminant concentration values. While the response to General Comment No. 1 indicates that the need for plume shell updates will continue to be evaluated during the development of future annual reports, the methodology for such an evaluation has not been provided. Such an evaluation should include the tabular comparison of predicted and observed contaminant concentration values and should be presented beginning with the current Environmental Monitoring Report.

Resolution: A tabular comparison of measured and predicted perchlorate and RDX concentrations will be developed and included within the report.

19) Pg 6-4, §6.2 **-** The text states that '"results of the transport evaluation indicated that the system is meeting the basis of design," and that "particle tacking in the model was used to develop the predicted system capture zone under current operating conditions (Figure 6-5). However, as noted above, an evaluation to verify that the flow model can reliably represent the hydraulic regime under current conditions has not been provided. Moreover, the potentiometric contours depicted Figure 6-5 do not correspond well with those depicted for the current monitoring events in Figures 4-2 and 4-3. The general shape of the potentiometric surfaces differ significantly. Most notably, the potentiometric surface depicted in Figure 6-5 does not show the area of potential bypass observed to the east and south of MW-215 cluster. In addition, the water levels depicted in Figure 6-5 range between 64.5 ft. and 67.5 ft. msl, while the water level shown for September 2010 monitoring event and depicted in Figure 4-2 range between 71.6 ft. and 75.6 ft msl. Similarly the water levels shown for the March 2011 monitoring event and depicted in Figure 4-3 range between 69.4 ft. and 73.2 ft msl. Thus, it does not appear that the predicted capture zone presented in Figure 6-5 was developed using current operating conditions.

Particle tracking used to predict and evaluate the system capture zone under current operating conditions should be based on a model that predicts closely the current hydraulic conditions in the area J-2 Range eastern plume. Prior to using the particle tracking for this purpose, the model should be recalibrated as necessary to reproduce these conditions. The ability of the model to accurately predict groundwater levels under current conditions should be clearly demonstrated.

Response: See response to Specific Comment #7.

Additional Comment: The response to Specific Comment No. 7 indicates that the groundwater model is calibrated to average conditions and accordingly will provide reliable predictions of capture over the long-term. The reliability of model predictions to demonstrate capture over the long-term may eventually be demonstrated. However, the model is currently being used to

evaluate capture under current conditions by superimposing the capture zones predicted based on a calibration to average condition over the currently observed distribution of contamination. As note in the original comment, the predicted and observed potentiometric surfaces do not match well in a number of locations. These discrepancies between observed and predicted water levels indicate that the capture zone predicted by the model may not provide a reliable demonstration of capture under current conditions. This potential uncertainty should be acknowledged in the text. It is further recommended that, until the reliability of the model is demonstrated, an analysis of the potentiometric contours developed from current water level data provide the principal means of evaluating capture during each individual monitoring event. Please also refer to EPA's comment on the response to SC #7.

Resolution: The following sentence will be added to Section 6.2:
"Discrepancies between observed and predicted water levels indicate that the capture zone predicted by the model on a year over year basis may not provide a reliable demonstration of capture under current conditions but over the long term the capture zone predicted by the model is believed to adequately represent capture using the current extraction system." An evaluation will also be provided in the RI/FS for the J-2 Range.

21) Pg 7-1, Section § 7.4 – Please continue to monitor MW-357M1, MW-358M1, and MW-57D at the frequencies previously specified.

Response: Disagree with continuing to monitor and would like to discuss.

Additional Comment: MW-357M1, MW-57D, and MW-358M1 are situated cross- or downgradient of uncaptured portions of the plume. MW-57D is sampled annually, and MW-357M1 and MW-358M1 are sampled biennially. These wells should be retained until this portion of the plume is predicted to have or measured to have attenuated. It has also been recently noted that a significant area of bypass may exist immediately to the east and south of monitoring well cluster MW-215.

Resolution: Will continue to monitor MW-357M1, MW-358M1, and MW-57D at the frequencies previously specified.

23) Figure 5-6 - Please add a note indicating the date of the perchlorate detections identified by the colored circles.

Response: A note will be added to Figure 5-6 to indicate that the perchlorate detections identified by the colored circles are the maximum measured during the reporting period. A note will also be added to Figure 5-12 to indicate that the RDX detections identified by the colored circles are the maximum measured during the reporting period.

To make the use of the colored circles more informative it would be appropriate to add another concentration level and associated color such as less than 0.5 µg/L or another lower appropriate value.

Response: The colored symbol scheme has been established for all reports and has been in place for several years and no changes are recommended.

More appropriate concentration ranges should be used for the individual well graphs to make the presentation of the perchlorate concentrations more informative relative to the cleanup goal of 2.0 µg/L.

Response: Concentration ranges will be updated to better represent the lower concentration measurements.

Additional Comment: If the scale of the trend graphs adequately identifies the well concentrations then no change in the legend will be required.

Resolution: Agreed.

25) 5-12 - Please add a note indicating the date of the RDX detections identified by the colored circles.

Response: The addition of dates to the colored circles would place too much information on an already crowded figure and obscure the well names, which are considered to be more important. This is especially true since concentrations were all measured within the same 12 month period. The concentrations indicated were all measured during the reporting period described in this annual report and the exact sampling dates are included in tables. No changes are recommended.

To make the use of the colored circles more informative it would be appropriate to add another concentration level and associated color such as greater than 2.0 µg/L or another lower appropriate value.

Response: See response to comment #23.

A more appropriate concentration range should be used for the individual well graphs to make the presentation of the RDX concentrations more informative relative to the criteria of concern (0.6 µg/L and 2.0 µg/L).

Response: Concentration ranges will be updated to better represent the lower concentration measurements.

Additional Comment: If the scale of the trend graphs adequately identifies the well concentrations then no change in the legend will be required.

Resolution: Agreed.

26) Figure 6-5 – EPA notes that the eastern and western detached lobes for perchlorate are not fully captured by the extraction system. Army should clearly demonstrate that the contamination not captured by the extraction wells will attenuate within an appropriate timeframe.

Response: The sentence "The perchlorate concentrations in the western detached lobe are predicted to be diminished to less than 2 µg/L in 2011 and in the eastern detached lobe are predicted to be diminished to less than 2 µg/L in 2015. " will be added to Section 6.2 to describe the simulated reduction in perchlorate concentrations. The measured plume outlines in Figures 1-2, 2-1, 4-1, 4-2, 4-3, 5-1, 5-6, 6-1, and 6-5 will be modified to reflect the reduction in plumelet size.

Additional Comment: When demonstrating that the detached lobes that are not captured by the extraction system will attenuate within an appropriate time frame, the Army should provide validation of model predictions with actual observed data to indicate that model predictions are sufficiently reliable to support their conclusion. Such an evaluation can be performed through comparison with observed and predicted contaminant concentrations over time at nearby locations. Otherwise, the Army should provide the necessary monitoring data to demonstrate the attenuation of contaminants in the detached lobes. For comparison, because of the limited amount of data available for the detached lobes, please also provide an alternative projection if the bypassed concentration is one order of magnitude greater than Army's estimate.

Resolution: The potential for migration of the plumelets east and west of the main J-2 Eastern plume will be further evaluated through sensitivity testing in the RI/FS for the J-2 Range.

EPA REVIEW OF RESPONSE TO COMMENTS ON DRAFT J-2 RANGE NORTHERN INTERIM ENVIROMENTAL MONITORING REPORT (DATED APRIL 26, 2012)

GENERAL COMMENTS

1) Please update the plume shell using data through 2011 and after addressing these comments. Consideration should be given to additional well installation downgradient of J2EW0001 to determine whether any contamination may be bypassing the extraction well.

   Response: The goal of the annual report is to document current conditions in light of historic trends and to make recommendations necessary to optimize the system. The recommendation presented in Section 7.2 of the final report will be expanded to include a potential update to the plume shell, if needed. A separate project note work plan will be prepared, outlining the work needed to determine if optimization of extraction well operations is warranted.

   Additional Comment: Given that the Army is planning additional investigation to assess the need for optimization of the extraction system, please include that as a recommendation of this monitoring report. Also, because the Army is in the process of completing the Feasibility Study for the J-2 Range plumes EPA requests that this monitoring report include a recommendation to update the northern plume shells using all available data. EPA believes that this needs to be done irrespective of the findings of the proposed supplemental investigation and not as a contingency. The update should be performed following the completion of the proposed supplemental investigation and before completing the Feasibility Study. Please edit the report accordingly.

   Resolution: A recommendation will be added to the J-2 Range Northern annual report to conduct additional investigation and to optimize the system based on the results of the additional investigation. A recommendation will also be added to the J-2 Range Northern annual report to update the plume shells for perchlorate and RDX following the completion of the proposed supplemental investigation.

2) The Project Note to be prepared for potential system optimization (see Specific Comments) should also include potential increase of the flow rate in J2EW0003 to capture currently uncaptured portions of the perchlorate plume.

   Response: The plume downgradient from extraction well J2EW0003 is predicted to attenuate to perchlorate concentrations less than 2 µg/L within a few years and recent groundwater data from J2EW3-MW-1-C and J2EW3-MW-2-C as well as MW-337M1 MW-327M1/2 support this prediction. Figures throughout the final annual report will be updated to better reflect this by drawing a smaller plume downgradient of well J2EW0003 and no change to the pumping rate is recommended.

   Additional Comment: It is not apparent from this response or from information in the annual report what the basis is for “drawing a smaller plume downgradient of well J2EW0003.” If this refers to updating figures to include the most recent groundwater data, it is not clear why that wasn’t done in the first place. Also, Army’s projections for time to cleanup are apparently based on very limited data supplemented with assumptions for the concentration of perchlorate in the bypassed plume; however, it is not apparent that Army has adequate characterization data to reliably estimate the perchlorate concentration. Please provide the basis for Army’s projection of time to cleanup for this bypassed plume and also provide an alternative projection if the bypassed concentration is one order of magnitude greater than Army’s estimate.

   Resolution: The plume in the area downgradient of extraction well J2EW0003 will be further evaluated through sensitivity testing in the RI/FS for the J-2 Range.

SPECIFIC COMMENTS

6) Pg 4-1, §4.2 - The Final J-2 Northern Rapid Response Action System Performance and Evaluation Plan (page 5.3) specifies that “long-term (hydraulic) monitoring measurements will be compiled as hydrographs and analyzed for trends in water level changes.” However, no hydrographs have been included in the Interim Environmental Monitoring Report. Please include in the monitoring report a set of hydrographs for monitoring locations and depths that are representative of the changes in groundwater levels observed throughout the site.

Response: The long term trends in water levels agreed to in the J-2 Eastern System Performance Monitoring Plan have been understood to refer to regional water levels at groundwater monitoring stations maintained by the USGS. A description of the regional water level trends is provided in paragraph 2 of Section 4.3. Hydrographs were created for the five wells used to evaluate long term water level trends and were used to develop the description provided in Section 4.3. The water level data for the five wells can be found at the following web addresses, which will be included in Section 4.3:

- http://waterdata.usgs.gov/nwis/dv/?site_no=414124070311401&agency_cd=USGS&referred_module=gw
- http://waterdata.usgs.gov/nwis/dv/?site_no=414139070311501&agency_cd=USGS&referred_module=gw
- http://waterdata.usgs.gov/nwis/dv/?site_no=414159070310501&agency_cd=USGS&referred_module=gw
- http://waterdata.usgs.gov/nwis/dv/?site_no=414219070313601&agency_cd=USGS&referred_module=gw

Additional Comment: Links were provided for only four wells not five as stated; however, it appears that there are only four appropriate USGS wells in Barnstable County. If a fifth well was also used please identify it. Please include the relevant USGS water level charts in an appendix to the monitoring report and in that appendix discuss in appropriate detail what the basis is for concluding that there was no significant difference between the regional water level changes and the site water level changes.

Resolution: The following text will be added to Section 4.3 to indicate the superiority of the USGS wells for tracking regional water levels: “The four USGS wells provide a detailed history of groundwater levels near the top of the regional groundwater mound. The USGS wells are superior to using J-2 Range monitoring wells because of their long data history and frequency of data collection (every 15 minutes) while the water level data at the J-2 Range wells are collected just a few times per year”

7) Pg 4-1, §4.2 - The Final J-2 Northern Rapid Response Action System Performance and Evaluation Plan (page 5.3) specifies that “potentiometric maps for the aquifer at selected depth intervals will be constructed and compared against model predictions to ensure that observed performance is within the range of conditions during the design simulation testing.” Only one potentiometric map for a single interval between -3.98 and -58.98 feet msl was prepared and presented as Figure 4-2. Potentiometric maps for other intervals, most notably, the shallow water table zone should be prepared and presented. Moreover, there is no comparison between predicted and observed water levels. Without this comparison, it is not possible to evaluate and confirm the ability of the model to accurately represent the

hydraulic system under current conditions. Please provide a comparison between predicted and observed water levels during the current monitoring period. This comparison should include a tabular presentation of predicated and observed water levels at each of the monitoring wells where water levels are collected. In addition, depictions of predicted and observed potentiometric surfaces should be provided for comparison. Any significant differences between predicted and observed water levels should be identified and the impact on model reliability evaluated. Comparisons of predicated and observed water levels at multiple depths should be included in this evaluation.

Response: The flow model, being used to support the perchlorate and RDX simulations, represents “average” flow field conditions based on historic data and simulated during the development of the RI/FS for the J2 Range. The only change to the flow model that is made from year-to-year is an update of the well file so that the pumping stress applied to the model is accurate. Therefore, it is expected that from one year to the next the flow model will either over or under predict measured conditions but in the long term the coupled flow and transport model will provide reliable predictions of perchlorate and RDX, provided that the plume shell is regularly updated to reflect the measured conditions. Therefore, discrepancies between measured and predicted water levels are expected and a well-by-well comparison of measured and predicted water levels will not add value to the report.

Additional Comment: The response indicates that the model is only intended to predict average hydraulic conditions. The response also further indicates that discrepancies between measured and predicted water levels during any specific monitoring event are expected. However, the model is being used during each monitoring event to evaluate capture and to project the migration of contaminants during each individual monitoring event. Such evaluations and predictions keep only be deemed reliable for any specific time period if model is demonstrated to be a reliable representation of hydraulic behavior and contaminant migration. In the absence of such a demonstration, the text should acknowledge the uncertainty in the model prediction and the evaluation of capture and contaminant migration should be based on the water-level and groundwater quality data collected during the reported monitoring event(s) (see Specific Comment No. 19). Before the Feasibility Study is completed, Army needs to demonstrate that the hydraulic model for the site is still accurate. In order to demonstrate that, Army will need to compare the model predictions and measured values for the site water level data with appropriate adjustments for baseline conditions. Deviations of the modeled water levels from the expected water level ranges should be minimized by recalibrating the model if necessary. Please edit the report to recommend that the hydraulic modeling be verified and calibrated as necessary prior to completing the Feasibility Study. For each subsequent monitoring event, the associated report should present predicted versus observed water levels in tabular format to demonstrate that the model continues to represent actual conditions.

Resolution: The EMR will be revised by adding the following text to the first paragraph of Section 6.1:

“The flow model represents “average” flow field conditions based on historic data and simulated during the development of the RI/FS for the J-2 Range. The only change to the flow model that is made from year-to-year is an update of the well file so that the pumping stress applied to the model is accurate. Therefore, it is expected that from one year to the next the flow model will either over or under predict measured conditions but in the long term the coupled flow and transport model will provide reliable predictions. Therefore, discrepancies between measured and predicted water levels are expected. Based on the current period data the model is likely over predicting water levels around the site.

8) Pg 4-2, §4.2 - The monitoring report concludes that “overall, the flow field analysis indicates that gradients are generally in the direction of the extraction wells at the plume elevation.” However,

examination of the potentiometric surface presented in Figure 4-2 indicates that there may be a significant area of bypass immediately to the east of extraction well J2EW003. The discussion of the flow field analysis should be revised to acknowledge this potential issue.

Response: The last sentence of the third paragraph of Section 4.2 will be modified by adding ", with the exception of the area immediately north and east of well J2EW0003. The perchlorate plume in this area though is predicted to be diminished to concentrations less than 2 µg/L by 2013. Therefore, even if some portion of the perchlorate plume is not captured in this area the concentrations will attenuate". The small plume downgradient of J2EW0003 should be smaller than drawn and will be reduced in size to coincide with predictions. Figures 1-3, 3-2, 4-1, 4-2, 5-1, 5-2, 5-3, 6-1 and 6-4 will be updated to reflect this decreasing plume size.

Additional Comment: Please delete the last newly proposed sentence. Please compare this cleanup estimate to the estimation of cleanup timeframes and maximum extent of perchlorate migration at 2 µg/L downgradient of J2EW0003 in the RRA workplan. Also, see the response to GC-2 with respect to the conceptualization of the plume downgradient of J2EW0003.

Resolution: The sentence "Therefore, even if some portion of the perchlorate plume is not captured in this area the concentrations will attenuate" will NOT be added. In addition, as noted in the resolution to GC #2, concerns regarding perchlorate concentrations downgradient of J2EW0003 will be addressed in the RI/FS.

10) Pg 4-2, §4.3 - The Final J-2 Northern Rapid Response Action System Performance and Evaluation Plan (page 5-3) specifies that "vertical gradients will be tabulated" and that "changes in vertical gradients in well clusters will be evaluated." The environmental monitoring report does not include a tabulation of vertical gradients at each well cluster, nor does it include an evaluation of changes in vertical gradients. The report merely states that "the vertical gradient analysis indicated in the 2009 annual report is assumed to continue to represent the vertical flow component of groundwater flow during the current evaluation period." No justification is provided for this assumption. Given the recent regional changes in water levels, the tabulation and evaluation of vertical gradients specified in the System Performance and Evaluation Plan should be provided in the current monitoring report. Any deviations from the conceptual model or simulated range of performance should be identified and evaluated for their impact on system performance.

Response: A tabular summary of calculated vertical gradients will be developed and described and both the text and table will be added to Section 4.2 of the report.

Additional Comment: EPA has received the table of vertical gradients. Please provide the proposed text discussing this data for review.

Resolution: The following text will be added to Section 4.2: "Water levels among the well clusters were used to calculate the vertical gradients within the J-2 Northern monitoring network. The table presents vertical gradients within the J-2 Northern Range monitoring network. The Table presents the vertical gradients for the annual synoptic event obtained during the reporting period and includes baseline (non-pumping) and operational conditions. The results indicate that the extraction wells have had the desired effect on the aquifer system. The hydraulic gradient changes at the near-field wells (J2EW1-MW1-A, B, C, J2EW2-MW3-A, B, C, J2EW3-MW1-A, B, and C) generally showed either reversed or enhanced flow in the direction of the extraction well screens in response to pumping. The hydraulic gradients exhibited at wells farther from the extraction wells did not change significantly between the ambient and the operational condition. The vertical gradient analysis for the site-wide monitoring network only provides very limited insight into the system performance, partly because of the highly conductive nature of the aquifer system and the significantly aquifer thickness relative to the pumping interval"

11) Pg 5-1, §5.1 – Please edit the text to reconcile the apparent discrepancy between the discussion in the first paragraph of this section, which refers to releases from multiple locations over several decades, with the first sentence in Section 5.1.1, which states that there is primarily a single source of contamination.

    Response: This is not a discrepancy. Section 5.1 refers to the J2 Range as a whole while Section 5.1.1 refers to the J2 Range Northern, specifically. No text changes are recommended.

    Additional Comment: The response is not correct. The first paragraph in Section 5.1 is only discussing the Northern plume and the text specifically states that the plume resulted from releases at multiple locations. Please correct the discrepancy between the two referenced paragraphs in EPA's original comment.

    Resolution: The word "locations" will be replaced with the word "times" in the last sentence of the first paragraph of Section 5.1.

13) Pg 5-2, §5.1.1 - The second full paragraph on the page appears to contain contradictory information. The first sentence states that contaminant concentrations have trended higher immediately downgradient of J2EW001; however, the second sentence presents information for J2EW-MW-1-B indicating a decrease in concentration and the second last sentence states that concentrations have continued to decline at all MW-300 series wells (located immediately downgradient of J2EW0001). Concentrations at J2EW-MW-1-C, a deeper well, have significantly increased, possibly indicating a plunging plume. Please rewrite this paragraph to clarify the characterization of the plume and eliminate the apparent inconsistencies. Please provide a detailed discussion of the trending higher concentrations detected at J2EW-MW-1-C. EPA notes that the screens at the MW-300 location may not be appropriately placed to detect any contamination potentially migrating beyond J2EW0001.

    Response: The sentence in the second paragraph will be revised to "The perchlorate concentration in the monitoring wells located immediately downgradient of the J2EW0001 extraction well have trended higher. The perchlorate concentration at J2EW-MW-1-B, downgradient of the mid-depth of the J2EW0001 extraction well screen has increased to 9.0 µg/L (April 2011) from 7.01 µg/L (August 2009) and the concentration at J2EW-MW-1-C, downgradient and slightly deeper than the bottom of the J2EW0001 well screen has increased to 198 µg/L (April, 2011) from 13.9 µg/L (August 2009), suggesting that the core of the plume extends slightly deeper than observed during the remedial investigation. Additional work is recommended to further evaluate this portion of the plume."

    The discussion in the third full paragraph should be edited because it is not apparent that a change in concentration from ND with a reporting limit of 1 µg/L to a concentration of less than 0.1 µg/L is a decrease. It would be appropriate to mention that a reduction in the detection levels was achieved for the most recent data as compared to historical data.

    Response: The paragraph will be rewritten for clarification to:

    "Perchlorate concentrations in the central lobe of the plume and upgradient of the J2EW0002 extraction well are decreasing as evidenced by a continued reduction in perchlorate concentrations at this well since startup. The perchlorate plume downgradient of this extraction well is defined by monitoring wells MW-348, J2EW-MW-1 and J2EW-MW-2. Perchlorate concentrations at MW-348M2 have decreased to 0.0277J µg/L (August, 2010) from a high of 51.6 µg/L in July 2005. Concentrations at J2EW-MW-2-A, B and C were measured to be 0.0237J µg/L, 0.0292J µg/L and 0.062 µg/L (August, 2010); however, since concentrations at these wells were previously reported as ND, at a reporting limit of 1 µg/L, it is not possible to determine a trend in the data."

Additional Comment: EPA has received Army's re-submittal of Figure 5-2 dated 1/6/2012 which shows two lobes with concentrations greater than 200 µg/L immediately upgradient of J2EW0001 in response to the detection of perchlorate at 198 µg/L at well screen J2EW1-MW1-C. Please indicate if this second 200 µg/L lobe was added without rekriging the data. Army has proposed further investigation of the plume upgradient of J2EW0001 to better define the plume configuration and concentrations. While two separate lobes are possible as shown in the resubmitted figure, the actual plume configuration can only be determined by the additional field investigation proposed. Although the resubmitted Figure 5-2 shows 2010 operating conditions; Army has stated that the final Figure 5-2 should be revised to depict 2011 operating conditions.

Replace "are" with "have been" in the newly re-written paragraph beginning: "Perchlorate concentrations in the central lobe of the plume…" Concentrations may begin to rise again in the future depending upon the concentrations originally located between J2EW0001 and J2EW0002. Please label the wells as J2EW2-MW-1-A instead of J2EW-MW-1, and J2EW2-MW-2-A,B,C instead of J2EW-MW-2.

No response has been provided to the concern that the screens at the MW-300 location may not be appropriately placed to detect any contamination potentially migrating beyond J2EW0001. EPA noted this same concern in the prior year comments, IAGWSP indicated that the M2 screens were believed to be directly in line with the most elevated upgradient perchlorate and RDX concentrations are were considered to be in a good position to indicate the effectiveness of well J2EW001 at capturing contamination. This may or may not be true if higher concentrations are migrating laterally through J2EW0001 and potentially under-flowing the capture zone. Please note this concern and add that this concern will be addressed through implementation of the J-2 Range Northern Plume J2EW001 Evaluation.

Resolution: The following sentence will be added to Section 5.0: "Cross-sections were not created using any statistical contouring software but rather using water quality and flow information and model predictions to interpret distributions"

The legend will be changed to indicate that "2011" conditions are reflected instead of "2010" conditions.

The word "are" will be replaced with "have been" in the newly re-written paragraph beginning: "Perchlorate concentrations in the central lobe of the plume…" Concentrations may begin to rise again in the future depending upon the concentrations originally located between J2EW0001 and J2EW0002.

Wells will be labeled as J2EW2-MW-1-A instead of J2EW-MW-1, and J2EW2-MW-2-A,B,C instead of J2EW-MW-2.

The second to last sentence of the third paragraph of Section 5.1.1 will be amended by adding the phrase "...perchlorate <u>at the mid-screen elevation</u> has not migrated…" The sentences "However, elevated perchlorate concentrations recently measured at the J2EW1-MW1-C screen and potentially migrating beyond the J2EW0001 capture zone may not be represented downgradient by either the MW-300M2 or MW-300M3 screens because of the elevation differences (Figure 5-2). Additional investigation downgradient of the J2EW0001 extraction well is recommended to insure that capture of the elevated perchlorate concentrations in the J2EW1-MW1-C screen is achieved." will be added following the amended sentence.

14) Pg 5-2, § 5.1.1, par 4 – It is indicated that perchlorate concentrations in the central lobe of the plume and upgradient of the J2EW0002 extraction well are decreasing as evidenced by a continued reduction

in perchlorate concentrations at this well since startup. Please discuss whether perchlorate concentrations are expected to rise in the future based upon the detection of perchlorate at 115 µg/L from MW-300M2 in January 2006.

Response: This was not discussed because it is evident in Figure 5-2 that the 2-200 µg/L perchlorate concentrations have largely migrated through the J2EW0002 capture zone and are currently being captured. The sentence “Perchlorate concentrations are not expected to increase at well J2EW0002 in the future because it is believed that, given the predicted travel times, the highest perchlorate concentrations have already migrated to the extraction well” will be added following the first sentence section header ““Central Lobes from Wood Road to J2EW0003” in Section 5.1.1.

Additional Comment: IAGWSP noted that it is evident that the 2-200 µg/L perchlorate concentrations have largely migrated through the J2EW0002 capture zone and are currently being captured. It is proposed that the following description be added to the report: “Perchlorate concentrations are not expected to increase at well J2EW0002 in the future because it is believed that, given the predicted travel times, the highest perchlorate concentrations have already migrated to the extraction well.” EPA noted this same concern in a prior year annual report. IAGWSP responded then that the elevated perchlorate concentrations measured at MW-300M2 during 2004 through 2007 are predicted to be just recently reaching J2EW0002 and are expected to increase as extraction continues drawing the plume toward the extraction well. EPA notes that concentrations have not continued to increase at J2EW0002. Please explain this discrepancy in responses, and provide a re-evaluation of capture if appropriate.

Resolution: The concentrations were expected to increase and the reason that they have not may be a result of a plume shell that needs updating. See IGWSP resolution response to GC#1. Any potential discrepancies will be resolved as necessary in the RI/FS.

15) Pg 5-2, § 5.1.1, par 5 – Please explain why perchlorate concentrations have remained fairly consistent from J2EW2-MW-3-B rather than exhibiting declining concentrations due to the influx of water behind J2EW0002.

Response: This may be simply because monitoring well J2EW2-MW3-B is so close to the stagnation point downgradient of the J2EW0002 extraction well and not moving at an appreciable velocity. No changes to the document are recommended.

Additional Comment: Please add the potential explanation for the contaminant behavior at J2EW2-MW3-B to the text of the report. Please describe whether the J2EW0001evaluation or potential future optimization should take this stagnation into account.

Resolution: The following sentence will be added to Section 5.1.1 paragraph 5: “Perchlorate concentrations at monitoring well J2EW2-MW-3-B have remained elevated at 15-20 µg/L, which may be because the monitoring well is so close to the stagnation point downgradient of the J2EW0002 extraction well and not moving at an appreciable velocity. Low perchlorate concentrations at MW-348M1/M2 and at J2EW2-MW2-A/B/C tend to support the idea that concentrations are remain elevated at J2EW2-MW3-B because of stagnation; however, further efforts will be conducted to evaluate the likelihood and potential impact of stagnation”.

16) Pg 5-3, § 5.1.1 – Please discuss the results from MW-327. Please change the sampling frequency at MW-327M2 to semi-annually due to increasing concentrations.

Response: See response to GC #2, above. Perchlorate at MW-327M2 has only been measured once (0.135 µg/L) using method SW6860, with a detection limit of 0.05 µg/L, during the reporting period. The most recent value of 0.718 µg/L was collected in September 2011, which is outside of

the monitoring period described in this report but is consistent with model predictions of some downgradient migration of this detached portion of the plume as it attenuates, and all detected concentrations to date are well within drinkable levels. Therefore, annual sampling at MW-327M2 is adequate for the current monitoring purpose. If future detections show increasing trends above and beyond model predictions a change in sampling frequency may be warranted.

Additional Comment: Please refer to EPA's comment on the response for GC#2.

Resolution: Recommend continued annual sampling. See IGWSP resolution response to GC#2.

20) Pg 6-1, § 6.1.1 - Please edit the first sentence to read: "…perchlorate plume is somewhat similar to the model ...." Please edit this report to discuss why the differences noted are not enough to justify an upgrade of the model prior to completing the RI/FS.

Response: The first sentence in Section 6.1.1 will be modified to "…perchlorate plume is somewhat similar to the model ....and width but displaying clearer segmentation and a slightly deeper core in the upgradient area than was known at the time the current plume shell was developed." Additional field work is being planned to evaluate capture of the upgradient segment of the plume at J2EW0001 and optimization of the system and plume shell may follow. The recommendation in section 7.2 of the Annual Report will be expanded include development of a project note briefly describing the additional field work.

Additional Comment: Please refer to EPA's comment on the response for GC#1.

Resolution: See IGWSP resolution response to GC#1.

22) Pg 6-1, §6.1.1 - Due to the rather broad concentration ranges used in the contouring of perchlorate concentration in Figure 6-1 (2-15 µg/l, 15-200 µg/l, and greater than 200 µg/l), it is very difficult to compare the actual predicted and observed contaminant concentration at each monitoring well. Please provide a table presenting predicted and measured perchlorate concentration values at each monitoring well where contaminant concentrations are measured. Such a table will facilitate the comparison of predicted and observed values and allow for a more thorough evaluation of the reliability of the transport model. Based on concentration values presented in this table, the monitoring report should provide a more detailed assessment of the reliability of the transport model.

Response: Comparison of model predicted versus observed plumes is intentionally qualitative in scope and, as such, is adequate to identify divergences of significance to the performance of the ETR system. A well by well tabulation will add unnecessary detail that does not provide a significant value to this comparison over the graphic depictions that are included in all annual reports. It is clear, based on a cursory overview of the figures, that there are several locations where measured and predicted concentrations would be in disagreement for a variety of reasons including, but not limited to, a flow model that is representative of average rather than annual conditions, and a relatively limited number of data points, with plumes developed by projecting measurements forward rather than having actual measurements. That is why a new plume shell is being recommended for the J2 Northern area. The contour levels shown in Figures 6-1 and 6-2 are believed to adequately represent the predictive capacity of the model and no changes are recommended.

Additional Comment: EPA concurs that a new plume shell is warranted for the Northern plume. Please refer to EPA's comment on the response to GC#1 and SC#7. Based on completion of the efforts described in GC#1 and SC#7, Army may forego including the well by well concentrations in this monitoring report but should plan to included them in support of the model verification when the revisions for GC#1 and SC#7 are made.

Resolution: Agreed.

23) Pg 6-2, § 6.1.1, par 4 – Please explain why model predicted concentrations are consistently greater than the measured concentrations at J2EW0002.

Response: The following sentence will be added to the end of the fourth paragraph of Section 6.1.1: “The predicted perchlorate concentrations at well J2EW0002 may be consistently greater than measured concentrations because of an over estimation of the mass of perchlorate in the area between J2EW0001 and J2EW0002, which was estimated using historic concentrations from the MW-293 monitoring wells”.

Additional Comment: It is described by IAGWSP that the predicted perchlorate concentrations at well J2EW0002 may be consistently greater than measured concentrations because of an over estimation of the mass of perchlorate in the area between J2EW0001 and J2EW0002. Please discuss whether the predicted concentrations at well J2EW0002 may be consistently greater than measured concentrations because some amount of mass may be bypassing the capture zone to the well. In addition, this response appears to contradict the response provided to MassDEP SP-9. Please clarify. Please explain whether the cumulative influent concentrations detected from J2EW0002 over the operating history are reflective of the concentrations formerly seen at Wood Road.

Resolution: The sentence “However, the measured concentrations of perchlorate at the MTUs would likely be better predicted using an updated plume shell, which is being recommended as part of this EMR evaluation” will be added to Section 6.1.1.

24) Pg 6-2, § 6.1.1, par 6 – Please explain why the model significantly under predicts the mass removed at each of the three extraction wells for the reporting period.

Response: The following text will be added to the end of the last paragraph of Section 6.1.1: “, likely because of the higher than anticipated measured perchlorate concentrations being extracted by the J2EW0001 well and seen at the J2EW1-MW1 monitoring wells”.

Additional Comment: The response did not provide an explanation as to why the model under-predicted the mass removed at J2EW0002 and J2EW0003.

Resolution: The following sentence will be added to Section 6.1.1: “However, the measured mass of perchlorate at the MTUs would likely be better predicted using an updated plume shell, which is being recommended as part of this EMR evaluation”.

In addition, the following sentence will be added after the second paragraph of Section 6.1.1: “It is important to recognize when evaluating the measured and predicted extracted perchlorate concentration and mass that while extracted concentrations are measured at each of the three extraction wells (J2EW0001, J2EW0002 and J2EW0003) the extracted masses are measured at the MTUs E & F and MTU G, where MTUs E & F represent extracted concentrations from J2EW0001 and J2EW0002 and MTU G represents extracted mass from J2EW0003”.

25) Pg 6-2, §6.1.2 - The results of particle tracking generated using the groundwater flow model developed for the J-2 Ranges are presented in Figure 6-4 and used to evaluate system capture under current conditions. However, as noted above, an evaluation to verify that the flow model can reliably represent the hydraulic regime under current conditions has not been provided. Hydraulic conditions, most notably water levels and pumping stresses, have recently changed. No discussion has been provided regarding how these changes have been accommodated in the current model. Prior to accepting the

evaluation of system capture based on particle tracking using the flow model, the monitoring report should provide a detailed discussion of any modifications to the model to accommodate recent changes in hydraulic conditions. The ability of the model to accurately predict groundwater levels under current conditions must be demonstrated.

Response: See response to Specific Comment #7.

Additional Comment: The response to Specific Comment No. 7 indicates that the groundwater model is calibrated to average conditions and accordingly will provide reliable predictions of capture over the long-term. The reliability of model predictions to demonstrate capture over the long-term may eventually be demonstrated. However, the model is currently being used to evaluate capture under current conditions by superimposing the capture zones predicted based on a calibration to average conditions over the currently observed distribution of contamination. As noted in the original comment, the predicted and observed potentiometric surfaces do not match well in a number of locations. These discrepancies between observed and predicted water levels indicate that the capture zone predicted by the model may not provide a reliable demonstration of capture under current conditions. This potential uncertainty should be acknowledged in the text. It is further recommended that, until the reliability of the model is demonstrated, an analysis of the potentiometric contours developed from current water level data provide the principal means of evaluating capture during each individual monitoring event. Please refer to EPA's comment on the response for SC#7.

Resolution: See response to resolution of Specific Comment #7.

26) Pg 6-2, §6.1.2 - As acknowledged in this section, the results of particle tracking presented in Figure 6-4 indicate that the easternmost portion of the plume slightly east of MW-313 is outside the capture zone created by J2EW0003. An evaluation of the potentiometric surface developed using current water level measurements and presented in Figure 4-2 similarly indicates that capture is not occurring east of J2EW0003. Consideration should be given to further system optimization to increase capture in this area.

Response: The last two sentences in the first paragraph of Section 6.2 will be replaced with the sentence "Model predictions indicate that the uncaptured perchlorate plume in the area slightly east of MW-313 and downgradient of J2EW0003 will attenuate to concentrations less than 2 µg/L in 2013".

Additional Comment: When demonstrating that the detached lobes that are not captured by the extraction system will attenuate within an appropriate time frame, the Army should provide validation of model predictions with actual observed data to indicate that model predictions are sufficiently reliable to support their conclusion. Such an evaluation can be performed through comparison with observed and predicted contaminant concentrations over time at nearby locations. Otherwise, the Army should provide the necessary monitoring data to demonstrate the attenuation of contaminants in the detached lobes. For comparison, because of the limited amount of data available for the detached lobes, please also provide an alternative projection if the bypassed concentration is one order of magnitude greater than Army's estimate.

Resolution: See resolution to specific comment #8

30) Pg 7-1, §7.4, Recommendations – Please continue to monitor MW-366M1 and MW-381M1 at the frequencies previously specified.

Response: Clarification is requested from the EPA as to the necessity of continuing to monitor MW-366M1 and MW-381M1.

Additional Comment: MW-366M1 and MW-381M1 were removed from the chemical monitoring program as a result of recommendations in the last annual report. Please clarify.

Resolution: MW-366M1 and MW-381M1 will remain out of the monitoring program.

37) Figure 6-1 - There are significant differences between the model-predicted conditions and the observed conditions depicted in this figure. Please edit this report, perhaps in the recommendations section, to discuss why the differences are not enough to justify an upgrade of the model prior to completing the RI/FS.

Response: see response to comment #19, above.

Please provide a more detailed description in the text as to how the observed winter 2011 conditions were developed given that the model results presented in this figure have significant differences from the observed results.

Response: see response to comment #19, above.

Additional Comment: Please refer to EPA's comment on the response for GC#1.

Resolution: See response to resolution GC#1.

Impact Area Groundwater Study Program

FINAL

J-2 Range Northern Interim Environmental Monitoring Report August 2010 through July 2011

Camp Edwards
Massachusetts Military Reservation
Cape Cod, Massachusetts

July 2012

<u>*Prepared for:*</u>
Army National Guard
Impact Area Groundwater Study Program
Camp Edwards, Massachusetts

<u>*Prepared by:*</u>
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Disclaimer

This document has been prepared pursuant to government administrative orders (U.S. EPA Region I SDWA Docket No. I-97-1019 and 1-2000-0014) and is subject to approval by the U. S. Environmental Protection Agency. The opinions, findings, and conclusions expressed are those of the authors and not necessarily those of the Environmental Protection Agency.

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Acronyms and Abbreviations

3-D	three-dimensional
cf	cubic feet
COC	contaminant of concern
Eff	Effluent
ETI	extraction, treatment, and infiltration
GAC	granular activated carbon
gpm	gallons per minute
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
Inf	Influent
IX	ion exchange
J	estimated value
MMR	Massachusetts Military Reservation
msl	mean sea level
MTU	modular treatment unit
ND	nondetect
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RRA	rapid response action
RSL	Regional Screening Level
TOM	top of the groundwater mound
U	non-detected value
µg/L	micrograms per liter

1.0 INTRODUCTION

This interim annual environmental monitoring report for the J-2 Range Northern plume provides analyses of plume dynamics and hydraulics including assessment of model-predictions against observed behavior; monitoring program effectiveness operational aspects of the rapid response action (RRA) extraction, treatment, and infiltration (ETI) system; and the in-plant effectiveness at treating extracted groundwater. Results of the two groundwater sampling rounds that were collected in August/September 2010 and February 2011 along with the results of the plant monitoring from August 2010 through July 2011 are discussed.

The J-2 Range is located adjacent to and southeast of the Massachusetts Military Reservation (MMR) Impact Area, and is the northernmost of the four former training ranges that comprise the Southeast Ranges (Figure 1-1). The Southeast Ranges are former military training ranges and defense contractor test ranges that operated from 1935 to 1997. The J-2 Range was used from 1935 through the 1980s.

1.1 Purpose

The J-2 Range Northern RRA ETI system was implemented to provide protection for public water supply well WS-2 and aquifer restoration by capturing and treating contaminated groundwater (ECC, 2005) until a long-term remedy can be selected for the plume via the remedial investigation/feasibility study process. The purpose of this report is to document the following activities:

- Assessment of system operations;
- Assessment of the treatment system's effectiveness at removing perchlorate and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) from groundwater;
- Evaluation of hydraulic conditions to assess aquifer response to pumping;
- Assessment of the chemical monitoring results;
- Comparison of model-predicted and observed results;
- Recommendations for future monitoring activities in the plant, chemical, or hydraulic networks.

1.2 Background

The J-2 Range Northern plume consists of groundwater contaminated with levels of perchlorate above the Massachusetts maximum contaminant level of 2 micrograms per liter (µg/L) and the EPA Health Advisory of 15 µg/L, and RDX above the current risk-based concentration of 0.6 µg/L, and the EPA Health Advisory of 2 µg/L. The perchlorate plume is far larger and has much higher concentrations than the RDX plume. The perchlorate plume (above 2 µg/L) is located beneath the source area and extends approximately 6,500 feet downgradient. The RDX plume (above 0.6 µg/L) is also present beneath the source area and extends approximately 1,900 feet downgradient.

The Final J-2 Northern Rapid Response Action System Performance and Evaluation Plan (ECC, 2006) is the approved plan for monitoring the J-2 Range Northern plume. Recommendations made in the Final J-2 Range Northern Groundwater Rapid Response Action 2007 Annual System Performance Monitoring Report (ECC 2009) were implemented for 2010 environmental monitoring programs. The approved chemical monitoring well network is presented in Table 1-1 and Figure 1-2. There were no deviations from the chemical monitoring plan during this reporting period.

2.0 J-2 RANGE NORTHERN TREATMENT FACILITIES AND WELLFIELD OPERATING CONDITIONS

This section describes the overall J-2 Range Northern ETI system configurations, the operational history of the components of the ETI system and the in-plant effectiveness of the treatment process from August 2010 through July 2011.

2.1 J-2 Range Northern Plume ETI System

The J-2 Range North ETI system began operation in September 2006 and consists of: three extraction wells pumping at a combined total flow rate of approximately 375 gallons per minute (gpm); the Wood Road ETI system consists of two modular treatment units (MTUs E and F); the Jefferson Road ETI system consists of one stand-alone treatment system (G); and four infiltration trenches located along the lateral boundaries of the perchlorate plume, where treated water infiltrates into the aquifer (Figure 2-1). Water extracted from J2EW0001 (75 gpm) and J2EW0002 (175 gpm) is treated at MTUs E and F, located at the intersection of Barlow and Wood Roads (also known as the Wood Road treatment system). The water is returned to the aquifer at the infiltration trenches located along Wood Road. Water extracted from J2EW0003 (125 gpm) is treated at Treatment Facility G located at the intersection of Barlow and Jefferson Roads (also known as the Jefferson Road treatment system). The water is then returned to the aquifer at the infiltration trenches located along Jefferson Road.

Each MTU is housed within an 8-foot by 40-foot shipping container and is designed to effectively remove perchlorate and explosives compounds from groundwater at influent flow capacities of 125 gallons per minute (gpm).

The water treatment system housed within each of the MTUs E and F and the Treatment Facility G is described by the process flow diagram shown on Figure 2-2. The treatment train for the groundwater consists of ion exchange (IX) to remove perchlorate, and then granular activated carbon (GAC) adsorption to remove explosives compounds. Each of MTUs E and F and the Treatment Facility G contains two parallel sets of three pressure vessels: and IX unit followed by a primary and then secondary GAC unit. The lead GAC vessel provides the initial stage of treatment for the removal of explosives compounds, and the secondary, or guard GAC vessel provides backup capacity, ensuring that any breakthrough of contaminants from the first two stages of treatment (IX and GAC) will be captured prior to discharge. Each IX vessel contains 29 cubic feet (cf) of resin for a total capacity of 58 cf. Each GAC vessel has a capacity of 1,000 pounds of GAC, for a total four-vessel capacity of 4,000 pounds.

The operation of the ETI system for the 12 month period of August 2010 through July 2011 is described in the following sections.

2.2 J-2 Range Northern Plume ETI Systems Operating History

The following discussion includes an overview and a summary of operations and maintenance of the systems.

2.2.1 Wood Road Treatment System Operations and Maintenance Summary

The Wood Road treatment system is a stand-alone mobile treatment facility comprised of two MTUs, each with a capacity to treat 125 gpm for a total capacity of 250 gpm. The system began full time operation on 6 September 2006 and has operated reliably with an "up time" of 97.0% since system start-up. Up-time is a measure of ETI system continuity of operation and is defined as the number of hours that groundwater is pumped from each extraction well and is actively treated within the MTUs during a given time period (usually monthly), divided by the number of elapsed hours during the period (expressed as a percentage).

During this reporting period, from 1 August 2010 through 31 July 2011, the Wood Road system had an up-time of 96.1%. Since there are two extraction wells feeding the Wood Road treatment system, there are times when one well is off due to some maintenance issue, but the other pump remains "up". Thus, the system is still considered to be active, though not as thoroughly effective as when both pumps are working. The up-time percentage incorporates this partial system operation.

During the reporting period, the Wood Road treatment system was down for approximately 683.1 hours out of 17,472 elapsed hours. This downtime consists of time when no groundwater extraction was taking place due to occasional power failures or system maintenance, as well partial downtime when groundwater was only pumped from a single extraction well.

2.2.2 Jefferson Road ETI System Operations and Maintenance Summary

The Jefferson Road ETI system began full-time operation on 5 September 2006 at a design flow rate of 125 gpm. The system has operated reliably with an up-time of 98.4% since system start-up.

During this reporting period, from 1 August 2010 through 31 July 2011, the Treatment Facility G system had an up-time of 99.1%. The Jefferson Road ETI system had three planned shutdowns (4 hours combined) and five unplanned shutdowns for a total of 83.1 hours of down time out of a total elapsed time of 8,736 hours.

Table 2-1 displays the downtime associated with this period and Figure 2-3 shows the total downtime since startup associated with the operation of each of these ETI systems.

3.0 J-2 RANGE NORTHERN ETI SYSTEMS PERFORMANCE RESULTS

The purpose of the ETI system performance evaluation is to assess trends in the performance of the treatment system and effectiveness of the system at treating the contaminants in the J-2 Range Northern plume.

3.1 In-Plant Monitoring

Sampling frequencies are as follows at each of the J-2 Range Northern treatment facilities (E, F and G):

- Monthly for perchlorate and explosives at the influent (INF);
- Monthly for perchlorate at a sampling location after ion exchange units (MID-1);
- Monthly for perchlorate at a sampling location after lead GAC unit (MID-2) after perchlorate breakthrough of the ion exchange unit;
- Monthly for explosives at MID-2 (after the lead GAC unit), and
- Monthly for perchlorate and explosives at the effluent sample location (EFF).

Note, at MTUs E and F the system influent is combined and thus only one influent sample is collected. This influent sampling location is located before the groundwater is split into two streams and sent to the individual MTUs. The method for calculating the mass removal (i.e., mass extracted from the aquifer) values presented in the following sections is the monthly influent concentration (C) multiplied by the average groundwater extraction flow rate (Q) multiplied by time of operation (T). The average flow rate, Q, is adjusted to incorporate system down time, if any (Table 2-1). For example, at MTUs E and F, Figure 3-1 plots the influent concentration (C) on a monthly basis, Figure 3-2 plots the influent volume treated (Q*T), and Figure 3-3 plots the calculated mass removed on a monthly basis (C*Q*T).

Field parameters are also measured prior to collecting the system effluent and influent samples. They include temperature, specific conductivity, dissolved oxygen, oxidation-reduction potential, pH, and turbidity. The sampling locations are shown in Figure 2-2. Analytical results, including COCs and field parameter measurements are presented in Tables 3-1 and 3-2.

3.2 Wood Road ETI System Operational Results

3.2.1 Influent

During the period from August 2010 through July 2011, RDX was detected in the influent of MTUs E and F only three times, with a maximum detected concentration of 0.305 µg/L (see Figures 3-1 and Table 3-1). Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) was not detected in influent samples collected during this reporting period. The influent perchlorate concentrations ranged from a high of 14.7 µg/L to a low of 10.8 µg/L during this period. The perchlorate concentration generally trended downward during this period, continuing a trend that began in October 2009. Field parameters were within their expected ranges.

3.2.2 Breakthrough of Contaminants of Concern

Breakthrough of RDX was detected at the Wood Road treatment system once during the reporting period. Perchlorate and HMX were not observed to breakthrough during the period. The breakthrough of RDX was detected in Unit E MTU on 7 March 2011 at mid-fluent sample location J2-MID-2E at a concentration of 0.262 µg/L (Table 3-1). The GAC media in the Unit E MTU was changed out on 4 April 2011.

3.2.3 Total Groundwater Volume Treated

During the current reporting period, the Wood Road treatment system extracted, treated, and infiltrated 124.3 million gallons (Figure 3-2). A total of 621.8 million gallons of groundwater have been processed by the Wood Road ETI system since its startup in September 2006 (See Table 3-3).

3.2.4 Mass Removals

During this reporting period, the Wood Road System removed 13.13 pounds of perchlorate and 0.22 pounds of RDX from the J-2 Range Northern plume (See Figure 3-3). Since its startup in September 2006, the Wood Road ETI system has removed a total of 64.87 pounds of perchlorate and 0.75 pounds of RDX (See Table 3-3).

3.2.5 Sampling Frequency Evaluation

The monthly sampling period described in Section 3.1 has been adequate to monitor for filter media breakthrough and to ensure that the plant effluent meets the discharge requirements. The detailed description of the sampling schedule to be continued is presented in Table 3-4.

3.3 Jefferson Road ETI System Operational Results

3.3.1 Influent Concentrations

As was observed during the last reporting period, RDX and HMX were not detected in any influent samples collected during the reporting period at Treatment Facility G. The concentrations of influent perchlorate were relatively stable, ranging from a low of 0.996 µg/L to a high of 1.20 µg/L (Table 3-2 and Figure 3-4). Field parameters were within their expected ranges.

3.3.2 Breakthrough of Contaminants of Concern

There was no breakthrough of COCs at the Jefferson Road Treatment Facility G at any of the GAC or IX vessels.

3.3.3 Total Groundwater Volume Treated

During this reporting period, the Jefferson Road ETI system extracted, treated, and infiltrated 65.7 million gallons of groundwater (Figure 3-5). The total volume treated since startup is 319.7 million gallons (Table 3-3).

3.3.4 Mass Removals

The Jefferson Road ETI System removed 0.62 pounds of perchlorate from the J-2 Range Northern plume during the reporting period. Since its startup in September 2006, the Jefferson Road ETI system has removed a total of 2.70 pounds of perchlorate (Table 3-3 and Figure 3-6). No detectable RDX mass has been removed by the system since start-up.

3.3.5 Sampling Frequency Evaluation

The monthly sampling period described in Section 3.1 has been adequate to monitor for filter media breakthrough and to ensure that the plant effluent meets the discharge requirements. As there were no identified impacts to the treatment system based on measurements of geochemical parameters in June 2009, future measurements of these parameters will be obtained only on an as-needed basis if problems develop in treatment of contaminated water. The detailed description of the sampling schedule to be continued is presented in Table 3-4. Geochemical sampling was conducted at system startup and will only be conducted in the future if it is believed that a changed in water chemistry may have caused contaminant breakthrough (ECC, 2008).

4.0 HYDRAULIC PERFORMANCE MONITORING

A hydraulic monitoring synoptic event was conducted for the J-2 Range Northern plume on 23 August 2010. The purpose of the hydraulic monitoring is to evaluate system performance through analysis of the aquifer's hydraulic response to system operations. In all cases throughout this annual, report mean sea level (msl) refers to the zero foot elevation of the NGVD29 datum.

4.1 Synoptic Water Level Measurements

The 23 August 2010 synoptic event was conducted to help determine changes in groundwater elevations and flow patterns in the vicinity of the J-2 Range Northern system. All of the extraction wells were operating at their design rates during these synoptic events and water level measurements were collected at all wells specified in the J-2 Range Northern Interim Environmental Monitoring Report September 2008 through July 2010 (USACE, 2011). The hydraulic monitoring network is shown in Figure 4-1. Table 4-1 lists the water level monitoring network and Table 4-2 presents water level data collected from the 23 August 2010 synoptic event and water level changes from 03 August 2009 to 23 August 2010 and includes observed changes.

4.2 J-2 Range Northern Groundwater Level Analysis

The water levels measured on 23 August 2010 were analyzed for potential data anomalies and errors and none were identified.

The water level data from the 23 August 2010 event ranged from 63.32 feet mean sea level (msl) at MW-55D in the northern end of the study area to 76.21 feet msl at MW-164M1 in the southern end of the monitoring network. The horizontal gradient calculated across the J-2 Range Northern plume for the August 2010 synoptic event was approximately 0.00136 feet/foot.

The water level data from monitoring wells with screen mid-points from -3.98 to –58.98 feet msl were used to construct groundwater potentiometric maps (Figures 4-2). These wells are screened at a similar elevation to the extraction wells which are screened from -3.98 to -58.98 ft msl. Water levels were not measured at the extraction wells. However to represent the true flow nature of the system, water levels at the extraction wells were estimated based on regional trend analysis and information obtained as part of system startup. The potentiometric analyses were aided by using SURFER (Version 9), a geo-mapping software package. Monitoring wells bolded in Figure 4-2 indicate the wells used to develop the potentiometric surface map. The other data collected in the cluster are used to assess vertical gradients.

As shown in Figure 4-2, the regional groundwater flow direction, based on water level measurements at the interval from -3.98 to -58.98 feet msl, is towards the northeast with convergent flow near the three extraction wells due to the hydraulic stress of pumping. The flow fields converge near the extraction wells, reflecting inward horizontal hydraulic gradients for the

interval represented. The horizontal hydraulic gradient is lower in the southern portion of the J-2 Range Northern plume, which measures approximately 0.00035 ft/ft, due to the proximity to the top of the groundwater mound (where the water levels are flat and the horizontal hydraulic gradient is lower) and increases away from the mound from south to north. Overall, the flow field analysis indicates gradients are generally in the direction of the extraction wells at plume elevation with the exception of the area immediately north and east of well J2EW0003. The perchlorate plume in this area though is predicted to be diminished to concentrations less than 2 µg/L by 2013. Contaminant concentrations downgradient of the J2EW0003 extraction well will be addressed in the RI/FS for the J-2 Range.

Water levels among the well clusters were used to calculate the vertical gradients within the J-2 Northern monitoring network. The table presents vertical gradients within the J-2 Northern Range monitoring network. The Table presents the vertical gradients for the annual synoptic event obtained during the reporting period and includes baseline (non-pumping) and operational conditions. The results indicate that the extraction wells have had the desired effect on the aquifer system. The hydraulic gradient changes at the near-field wells (J2EW1-MW1-A, B, C, J2EW2-MW3-A, B, C, J2EW3-MW1-A, B, and C) generally showed either reversed or enhanced flow in the direction of the extraction well screens in response to pumping. The hydraulic gradients exhibited at wells farther from the extraction wells did not change significantly between the ambient and the operational condition. The vertical gradient analysis for the site-wide monitoring network only provides very limited insight into the system performance, partly because of the highly conductive nature of the aquifer system and the significantly aquifer thickness relative to the pumping interval.

4.3 Regional Groundwater Level Changes

The 23 August 2010 water level data were analyzed and compared with the earlier synoptic water level measurements under operational conditions to evaluate long-term changes in water levels and identify trends (Table 4-2). The change in groundwater level between 3 August 2009 and 23 August 2010 ranged from +4.27 feet to +5.64 feet and averaged 5.15 feet.

These increases in water levels are consistent with regional increases in water levels for this same time frame as measured at several USGS monitoring wells where water level measurements are recorded every 15 minutes by a pressure transducer data logging system. This data is available on the USGS websites:

- http://waterdata.usgs.gov/nwis/dv/?site_no=414124070311401&agency_cd=USGS&referred_module=gw
- http://waterdata.usgs.gov/nwis/dv/?site_no=414139070311501&agency_cd=USGS&referred_module=gw
- http://waterdata.usgs.gov/nwis/dv/?site_no=414159070310501&agency_cd=USGS&referred_module=gw

- http://waterdata.usgs.gov/nwis/dv/?site_no=414219070313601&agency_cd=USGS&referred_module=gw

The four USGS wells provide a detailed history of groundwater levels near the top of the regional groundwater mound. The USGS wells are superior to using J-2 Range monitoring wells because of their long data history and because the frequency of data collected at the USGS wells is once every 15 minutes while the water levels at the J-2 Range wells are only measured just a few times per year.

4.4 J-2 Range Northern System Performance Evaluation

There have been no changes to the pumping rates at the three extraction wells at the J-2 Northern system and the vertical gradient analysis indicated in the 2009 annual report (USACE, 2011) is assumed to continue to represent the vertical flow component of groundwater flow during the current evaluation period. Groundwater gradients for the current evaluation period can be inferred from water level data presented in Table 4-2.

5.0 CHEMICAL MONITORING

An annual sampling event was completed in August/September 2010, and a semi-annual event was conducted in February 2011. The current chemical monitoring network is presented in Table 1-1, sample locations are depicted on Figure 1-2 and sample results are presented in Table 5-1. Figure 5-1 depicts the plan view of the perchlorate plume and the lines of cross-sections and Figures 5-2 depicts perchlorate concentrations along the cross-sections. Figure 5-3 depicts the plan view of the perchlorate plume with graphs of historical perchlorate concentrations at selected wells. Cross-sections were not created using any statistical contouring software but rather using water quality and flow information and model predictions to interpret distributions.

Figure 5-4 depicts the plan view of the RDX plume and the lines of cross-sections and Figure 5-5 depicts RDX concentrations along cross-section A-A'. Figure 5-6 depicts the plans view of the RDX plume with graphs of historical RDX concentrations at selected wells.

Sample collection, and field monitoring equipment calibration and maintenance, was conducted in accordance with approved procedures (ECC, 2007a).

5.1 Monitoring Results

The two primary site-related contaminants in the J-2 Range Northern groundwater study area are perchlorate and RDX. Although there is a high degree of commingling of the perchlorate and RDX contamination within the J-2 Range Northern plume, there is some variability in the mass distribution of perchlorate and RDX within the plume. This is largely due to the fact that the plume resulted from releases at multiple times on the J-2 Range over a time frame spanning several decades.

The perchlorate detections are more longitudinally extensive than the RDX detections. The vertical perchlorate distribution is shown on cross section A-A' (Figures 5-2). Select perchlorate trends are also shown on Figure 5-3. The distribution of RDX is shown on Figure 5-4 and on cross section A-A' (Figures 5-5). Select RDX trends are shown on Figure 5-6.

The representation of concentrations and contaminant distributions shown in these figures and discussed in this section were developed conservatively using both historical "profile" data and fixed well analytical data, and considering the groundwater flow trajectories inferred from the groundwater elevation contours that have been mapped within the study area. Monitoring results were used to develop interpretations of current plume size and shape; however, it is important to consider that the spatially limited monitoring well data requires that concentrations be forward migrated in order to fill in areas without monitoring wells and the highest concentrations may be interpreted in areas without recently measured data. The geology depicted on the cross sections was based on available drilling information and professional judgment.

5.1.1 Perchlorate

As noted above, there is primarily a single source of contamination at the J-2 Range Northern plume that has resulted in a longitudinal plume. The J-2 Range Northern Plume (above 2 µg/L) was mapped as a main lobe extending from the source area downgradient. The main lobe of the perchlorate plume (above 2 µg/L) is approximately 6,800 feet long and approximately 800 feet wide at its widest point. The current conceptual understanding of the J-2 Range Northern plume is very similar to the understanding at the time the ETI system was designed (ECC 2008), with some minor changes.

Beneath Source Area to Wood Road

Perchlorate concentrations at MW-130M1 have remained ND in 14 of 17 samples since initially being sampled in 2000 with the only exception being estimated concentrations of 0.588 µg/L and 0.357 µg/L measured in 2008 and 2009, respectively, and a concentration of 0,387 µg/L measured in 2010. Concentrations at MW-130S have declined from a high of 4.21 µg/L measured in 2001 to a concentration of 0.202 µg/L measured in 2010. The perchlorate concentrations at MW-130D have remained ND in eight of nine samples, since initially being sampled in 2000, with the only exception being an estimated concentration of 0.0338 µg/L measured in 2010. The perchlorate concentrations at MW-230M2 have remained ND in 11 of 12 samples since initially being sampled in 2002 with the only exception being an estimated concentration of 0.106 µg/L measured in 2010. Concentrations at MW-230M1 have remained ND in 12 of 13 samples, since initially being sampled in 2002, with the only exception being 0.585 µg/L measured in 2010. Concentrations at MW-234M2 have been ND in 10 of 14 samples since 2002 from a high estimated concentration of 1.2 µg/L to a low concentration of 0.163 µg/L in 2010. At MW-234M1, concentrations have varied between 3.7 µg/L measured in 2006 to a low of 0.331 µg/L measured in 2010.

The concentration in the monitoring wells located immediately downgradient of the J2EW0001 extraction well have trended higher. The perchlorate concentration at J2EW-MW-1-B, downgradient of the mid-depth of the J2EW0001 extraction well screen has increased to 9.0 µg/L (April 2011) from 7.01 µg/L (August 2009) and the concentration at J2EW-MW-1-C, downgradient and slightly deeper than the bottom of the J2EW0001 well screen has increased to 198 µg/L (April, 2011) from 13.9 µg/L (August 2009), suggesting that the core of the plume extends slightly deeper than observed during the remedial investigation. Additional data collection is recommended to further evaluate this portion of the plume. Perchlorate concentrations have continued to decline at all MW-300 wells (M1/M2/M3) suggesting that perchlorate at the mid-screen elevation has not migrated beyond the J2EW0001. However, elevated perchlorate concentrations recently measured at the J2EW1-MW1-C screen and potentially migrating beyond the J2EW0001 capture zone may not be represented downgradient by either the MW-300M2 or MW-300M3 screens because of the elevation differences (Figure 5-2). Elevated perchlorate concentrations in the J2EW1-MW-1-C monitoring well, located downgradient of well J2Ew0001 have raised concern that the elevated perchlorate concentrations are not being captured by the J2EW0001 extraction well. Modeling simulations have been run and evaluated to try and determine the likelihood of capture by J2EW0001;

however, the results of the modeling were generally inconclusive since the margin of predicted capture was small. Modeling did indicate that any contaminant that may not be captured by the J2EW0001 well will be captured by the J2EW0002 well. Additional investigation downgradient of the J2EW0001 extraction well is recommended to insure that capture of the elevated perchlorate concentrations in the J2EW1-MW1-C screen is achieved. Perchlorate concentrations at all monitoring wells along Wood Road continue to decrease.

Central Lobe from Wood Road to J2EW0003

Perchlorate concentrations in the central lobe of the plume and upgradient of the J2EW0002 extraction well have been decreasing as evidenced by a continued reduction in perchlorate concentrations at this well since startup. Perchlorate concentrations are not expected to increase at well J2EW0002 in the future because it is believed that, given the predicted travel times, the highest perchlorate concentrations have already migrated to the extraction well. The perchlorate plume downgradient of this extraction well is defined by monitoring wells MW-348, J2EW2-MW-1-A and J2EW2-MW-2-A,B,C. Perchlorate concentrations at MW-348M2 have decreased to 0.0277J µg/L (August, 2010) from a high of 51.6 µg/L in July 2005.Concentrations at J2EW-MW-2-A, B and C have decreased to 0.0237J µg/L, 0.0292J µg/L and 0.062 µg/L (August, 2010); however, since concentrations at these wells were previously reported at ND, at a reporting limit of 1 µg/L, it is not possible to determine a trend in the data.

Concentrations in the lobe downgradient of J2EW0002, as indicated by J2EW2-MW-3A at the upgradient portion of the plume and by MW-313M2 in the downgradient portion of the plume, have not changed much from previous sampling. The perchlorate concentration at J2EW2-MW-3-A and C were 0.0417J µg/L and 0.0229J µg/L (August, 2010) and have been ND at a reporting limit of 1 µg/L since October 2007. The concentration at J2EW2-MW-3-B was 21.8 µg/L (September 2010) which is slightly higher than the 18.1 µg/L measured previously (August, 2009). Perchlorate concentrations at monitoring well J2EW2-MW-3-B have remained elevated at 15-20 µg/L, which may be because the monitoring well is so close to the stagnation point downgradient of the J2EW0002 extraction well and not moving at an appreciable velocity. Low perchlorate concentrations at MW-348M1/M2 and at J2EW2-MW2-A/B/C tend to support the idea that concentrations are remain elevated at J2EW2-MW3-B because of stagnation; however, further efforts will be conducted to evaluate the likelihood and potential impact of stagnation. The perchlorate concentration of 1.16 µg/L (February, 2011) measured at the J2EW0003 extraction well has shown a slight increase since August 2009.

Lobe Downgradient of J2EW0003

Perchlorate concentrations within a small detached plume located downgradient of the J2EW0003 extraction well have been consistently decreasing and are expected to attenuate without ever reaching or exceeding groundwater standards. The J2EW3-MW-2-C monitoring well is located at the expected highest concentration portion of the detached plume and was measured to have 1.42 µg/L (August, 2010), which is significantly less than the 3.05 µg/L (August, 2009) measured previously. The downgradient portion of the plume is monitored by well MW-337 which had a recently measured perchlorate concentration of 0.138 µg/L but that

has had ND values since September 2004, until recently when the lowered detection limit resulted in three consecutive very low detections. Data in the area downgradient of extraction well J2EW0003 will be carefully evaluated during the plume shell update, which is being recommended as a result of the evaluation presented in this annual report.

5.1.2 RDX

The J-2 Range Northern RDX plume (above 0.6 µg/L) consists of one main lobe extending from the source area downgradient to the J2EW0001 extraction well. This main lobe is approximately 2,250 feet long and approximately 470 feet wide at the widest point. The current conceptual understanding of the J-2 Range Northern plume is very similar to the understanding at the time the ETI system was designed (ECC 2008), with some minor changes.

RDX concentrations in the immediate vicinity of the source area are monitored by the relatively shallow MW-234M2 and the slightly deeper MW-234M1. The concentration at MW-234M1 was recently measured to be 2.12 µg/L (August, 2010) which is significantly less than the historically high concentration of 15.5 µg/L (September, 2008). Similarly, the concentration at MW-234M2 was recently measured to be 0.17 µg/L (August, 2010), which is significantly less than the historically high concentration of 0.74 µg/L (October, 2002). Concentrations of RDX at MW-230M2 and MW-230M1 have consistently been measured at ND in all samples collected since 2002 and including samples collected in 2010. Similarly, RDX concentrations measured at MW-130D were ND in all eight samples collected from 2000 through 2006 and at MW-130M1 were ND in all 18 samples collected from 2000 through 2010. RDX concentrations at MW-130S have decreased form a high of 4.4 µg/L to a low concentration of 0.153 µg/L measured in 2010.

RDX concentrations approximately midway between the source area and the downgradient J2EW0001 extraction well are monitored at MW-289M2. The RDX concentration at MW-289M2 was measured to be 1.98 µg/L (August, 2010), which is slightly lower than the previous measurement of 2.18 µg/L (August, 2009) but significantly less than the historically high concentration of 140 µg/L (September, 2003).

The monitoring well screen located immediately downgradient of the J2EW0001 extraction well screen is J2EW1-MW-1-B. The RDX concentration at this location has been ND since October 2008. The deeper RDX lobe evident at J2EW-MW-1-C was measured to be 2.68 µg/L (September 2010), which is higher than the previous measurement of 0.978 µg/L (August, 2009), suggesting that the core of the plume extends slightly deeper than observed during the remedial investigation.

5.1.3 Other Explosives

In addition to perchlorate and RDX, HMX was detected in four samples collected from four monitoring wells. The EPA health advisory for HMX is 400 µg/L. The maximum concentration detected was 3.0 µg/L at MW-289M2. Other explosives constituents were also detected at three wells including MW-130S, MW-234M1 and MW-234M2. The compounds detected were 2-Amino-4,6-Dinitrotoluene, 1,3-Dinitrobenzene, 2,4,6-Trinitrotoluene (TNT), 2,4-Dinitrotoluene, 2-

Amino-4,6-Dinitrotoluene and 4-Amino-2,6-Dinitrotoluene and the highest concentration was 6.7 µg/L of 2-Amino-4,6-Dinitrotoluene at MW-234M2 (Table 5-1).

The concentrations of all these other explosives are low and so the detection of these compounds does not affect the rapid response action design objectives, and these detections are not anticipated to diminish treatment system effectiveness.

There are no Massachusetts GW-1 standards nor Federal drinking water standards for the compounds: 2-Amino-4,6-dinitrotoluene, 4-Amino-2,6-dinitrotoluene, and 2,4,6-trinitrotoluene. HMX, however, has a Massachusetts GW-1 standard of 200 µg/L, and similar to TNT, has a Federal Health Advisory (HA) standard; HMX (400 µg/L) and TNT (2 µg/L). Additionally, 2-Amino-4,6-dinitrotoluene, 4-Amino-2,6-dinitrotoluene, and 2,4,6-trinitrotoluene have risk based EPA Regional Screening Level (RSL) drinking water standards of 73 µg/L, 73 µg/L and 18 µg/L, respectively.

6.0 GROUNDWATER MODELING

Various modeling tools were used to evaluate the performance of the J-2 Range Northern ETI system and the J-2 Range Northern plume. Modeling-predictions from the revised perchlorate plume shells developed with data through September 2007 (model date 2007.75) were compared to recently observed concentrations at monitoring wells, influent concentrations, and mass removal to assess the plume shell and identify potential areas for optimization.

6.1 Model Predictions versus Observed Concentrations

After system startup, the flow model was recalibrated to the observed hydraulic responses (ECC, 2010) and transport models were developed to evaluate model-predicted system performance from September 2007 (2007.75) and beyond. Plume shells used for analyses of perchlorate and RDX were constructed using data through October 2007 and the model and migrating the 2007.75 plume shells to model date 2011.17. All transport parameters were identical to those described in the Draft J-2 Groundwater Remedial Investigation/Feasibility Study report (ECC, 2007b). For this annual report, the only changes to the model were to incorporate hydraulic stresses that have changed within the model domain, namely changes to injection/extraction rates at the FS-12 and J-1 Range Southern ETI systems. These changes were incorporated into the MODFLOW well files.

Data collected through February 2011 (model date 2011.17) were used to confirm the most recent depictions of perchlorate. The observed conditions are presented in comparison to model-predicted conditions using the model and the 2007.75 plume shell using the model and migrating the 2007.75 plume shells to model date. Stresses within the system were accounted for in the development of the MODFLOW well file. Comparisons of measured and predicted perchlorate and RDX concentrations are summarized in Table 6-1.

The modeling activities consisted of evaluating model-predicted concentrations in monitoring wells, model-predicted extraction well influent concentrations, and model-predicted mass capture for extraction wells and the system as a whole. The evaluation was conducted by comparing model-predicted results to observed results. The RDX plume was not included in the evaluation because it is co-located and much smaller than the perchlorate plume.

The flow model represents “average” flow field conditions based on historic data and simulated during the development of the RI/FS for the J-2 Range. The only change to the flow model that is made from year-to-year is an update of the well file so that the pumping stress applied to the model is accurate. Therefore, it is expected that from one year to the next the flow model will either over or under predict measured conditions but in the long term the coupled flow and transport model will provide reliable predictions. Therefore, discrepancies between measured and predicted water levels are expected.

6.1.1 Perchlorate

The recently observed perchlorate plume is somewhat similar to the model predicted (Figure 6-1) plume, having approximately the same length and width but displaying clearer segmentation and a slightly deeper core in the upgradient area than was known at the time the currently plume shell was developed.. The extent of the 2 µg/L perchlorate plume boundary at the source area is slightly larger than the predicted plume in this area. The central portion of the perchlorate plume is predicted to be larger than that of the measured plume including the extent of the 2 µg/L and the 15 µg/L perchlorate plume boundary. The downgradient portion of the perchlorate plume is predicted to be larger than the measured plume and does not show as much of the downgradient migration of perchlorate concentrations above 15 µg/L northeast of extraction well J2EW0002. Similarly, the transport model does not depict the plumes as being segmented as defined by concentrations of perchlorate at Wood Road below 2 µg/L.

Influent perchlorate concentrations at the J-2 Range Northern plume extraction wells are measured monthly at the treatment systems. Figure 6-2 presents the measured extracted groundwater concentrations (prior to treatment) compared to model predicted extracted groundwater concentrations for each extraction well.

It is important to recognize when evaluating the measured and predicted extracted perchlorate concentration and mass that while extracted concentrations are measured at each of the three extraction wells (J2EW0001, J2EW0002 and J2EW0003) the extracted masses are measured at the MTUs E and F and Treatment Facility G, where MTUs E and F represent extracted concentrations from J2EW0001 and J2EW0002 and Treatment Facility G represents extracted mass from J2EW0003.

At J2EW0001, model predicted concentrations are consistently less than the measured concentrations throughout the reporting period. At the start of the period, measured concentrations are approximately 20 µg/L and predicted concentrations are approximately 14 µg/L and by the end of the reporting period the measured concentrations are approximately 17 µg/L and the predicted concentrations are approximately 10 µg/L.

At J2EW0002, model predicted concentrations are consistently greater than the measured concentrations throughout the reporting period. At the start of the period, measured concentrations are approximately 3 µg/L and predicted concentrations are approximately 7 µg/L and by the end of the reporting period the measured concentrations are approximately 2 µg/L and the predicted concentrations are approximately 5 µg/L. The predicted perchlorate concentrations at well J2EW0002 may be consistently greater than measured concentrations because of an over-estimation of the mass of perchlorate in the area between J2EW0001 and J2EW0002, which was estimated using historic concentrations from the MW-293 monitoring wells.

At J2EW0003, model predicted concentrations are consistently less than the measured throughout the reporting period. At the start of the period, measured concentrations are

approximately 1 µg/L and predicted concentrations are marginally less and by the end of the reporting period the concentration of each is approximately the same.

Figure 6-3 plots cumulative mass removed since startup (measured vs model predicted) for each extraction well. Extraction wells J2EW0001 and J2EW0002 (MTUs E and F) removed approximately 13.13 pounds of perchlorate from 1 August 2010 through 31 July 2011. This compares to a model predicted mass removal of 6.89 pounds for the same period. At extraction well J2EW0003 (Treatment Facility G), the treatment plant removed 0.62 pounds of perchlorate between 1 August 2010 through 31 July 2011. This is in comparison to 0.36 pounds predicted by the model. The total perchlorate measured to be removed by the treatment plants between 1 August 2010 and 31 July 2011 was 13.75 pounds and the total predicted to be removed was 7.26 pounds. In general, the model under-predicted the mass removed at extraction wells J2EW0001and J2EW0003 but likely over-predicted the mass removed by well J2EW0002, as indicated by the measured and predicted concentrations illustrated in Figure 6.2. This is particularly true for the mass predicted to be removed by MTUs E and F, which are a composite of extracted groundwater from both the J2EW0001 and J2EW0002 extraction wells. However, the measured concentrations of perchlorate at the MTUs and the Treatment Facility would likely be better predicted using an updated plume shell, which is being recommended as part of this EMR evaluation.

6.2 J-2 Range Northern Plume ETI System Capture Zone

The results of the transport evaluation indicated that the system is meeting the basis of the design. Particle tracking in the model was used to develop the predicted system capture zone under current operating conditions (Figure 6-4). The particle traces from extraction wells J2EW0001 and J2EW0002 completely envelop the respective upgradient perchlorate plume, as does the particle traces from extraction wells J2EW0003 with the exception of the easternmost portion of the plume slightly east of monitoring well MW-313, which is slightly outside of the capture zone. Model predictions indicate that the uncaptured perchlorate plume in the area slightly east of MW-313 and downgradient of J2EW0003 will attenuate to concentrations less than 2 µg/L in 2013.

Elevated perchlorate concentrations have recently been measured at monitoring well J2EW1-MW1-C located downgradient of extraction well J2EW0001. This may suggest that there is a potential for the upgradient plume to be migrating past the extraction well. For example, the perchlorate concentration at well J2EW1-MW1-C has increased from 1.81 µg/L in October 2007 to 13.9 µg/L in August 2009 to 198 µg/L in April 2011. While the predicted vertical capture zone for the J2EW0001 extraction well indicates that J2EW1-MW1-C is effectively captured, the overlap is marginal and optimization of this capture zone by adjusting the extraction rate may result in a more reliable capture of the upgradient perchlorate plume.

6.3 Discussion

The 2007.75 plume shell continues to be a better predictive tool for J-2 Range Northern plume transport than previous model variants. The model-predicted hydraulic response to system start-up at J-2 Range Northern plume is good when compared to observed data at most locations.

In several instances, the model under-predicts the hydraulic response, suggesting model-predictions of system performance may be conservative. The observed hydraulic stress in the aquifer imposed by system operation is greater than predicted by the model. Therefore, hydraulic gradients to the wells are steeper than predicted and plume capture is also likely under-predicted. The delayed drawdown response observed in the evaluation of the six-month synoptic data indicates the model is also under-predicting the long-term hydraulic response of the ETI system.

However, the over-prediction of perchlorate removal from the extraction wells may be a result of an under-estimate of perchlorate mass in the aquifer and may therefore lead to an increase in cleanup time. This is particularly relevant given the unaccounted for increase in perchlorate concentrations at the J2EW1-MW-1-C monitoring well. The model-predicted gradient across the site is very similar to the observed gradient and the predicted flow field under average water level conditions is a good match to observed long-term plume trajectories.

The results of the capture zone and transport evaluations indicate the system is meeting the basis of design; however, consideration may be given to increasing the flow rate at J2EW0001 to ensure adequate capture of J2EW1-MW1-B/C which is located on the downgradient edge of the J2EW0001 capture zone.

7.0 RECOMMENDATIONS

Recommendations for modification to the J-2 Range Northern ETI system operations and monitoring are presented in this section.

7.1 Plant Operations and Sampling

During this reporting period, breakthrough of RDX was observed from the first GAC vessel in the treatment train of MTU E. This breakthrough was detected during monthly monitoring and GAC change-out was quickly performed. This process resulted in no effluent discharges of the COCs. Thus, the Wood Road and Jefferson Road ETI systems are treating groundwater as designed. As a result, no changes are recommended to the current system operating and monitoring procedures.

7.2 Well Field Recommendations

There are no recommendations for modifying the hydraulic well field at this time; however, consideration should be given to using the existing groundwater model to optimize extraction rates at the J2EW0001 and J2EW0002 extraction wells to expand the J2EW0001 capture zone in the downgradient direction and to more reliably capture the elevated perchlorate concentrations recently measured at J2EW1-MW1-B/C.

7.3 Hydraulic Monitoring Network Recommendations

There are no recommendations for modifying the hydraulic monitoring network.

7.4 Chemical Monitoring

Several wells (MW-366M1/M2/M3 and MW-381M1/M2) that are currently included within the J-2 Northern monitoring plan are located more than 1,200 feet east of the centerline of the main lobes of both the perchlorate and RDX plumes and plumelets. Additionally, these wells have consistently, with few exceptions, had perchlorate and RDX concentrations that have been ND or significantly less than their respective regulatory thresholds. The continued chemical monitoring of these wells does not provide any additional useful information regarding the perchlorate and RDX plumes and it is recommended that these wells be removed from the J-2 Northern monitoring program.

The following wells are proposed for removal from the chemical monitoring program:

- MW-366M2 – Located 1,500 feet southeast of the J2EW0001 extraction well. Perchlorate has been measured nine times since 2005 and reported as ranging from <1 µg/L to 0.84J µg/L for the eight samples collected from 2005 to 2009 and 0.38 µg/L for the sample collected most recently in 2010. RDX has been measured nine times since 2005 and reported as ranging from 0.33 µg/L to 0.73 µg/L for the three samples

collected in 2005 and non-detect for the six samples collected since 2005 including the sample collected most recently in 2010.

- MW-366M3 – Located 1,500 feet southeast of the J2EW0001 extraction well. Perchlorate has been measured nine times since 2005 and reported as ranging from 0.64J µg/L to 2.3 µg/L for the three samples collected in 2005, non-detect for the five samples collected from 2006 to 2009, and 0.0434J µg/L for the sample collected most recently in 2010. RDX has been measured nine times since 2005 and reported as non-detect in all samples collected.
- MW-381M2 – Located 1,500 feet due east of J2EW0001 and along Wood Road. Perchlorate has been measured fifteen times since 2005 and reported as non-detect for the fourteen samples collected from 2005 to 2009 and 0.0118J µg/L for the sample collected most recently in 2010.RDX has been measured fifteen times since 2005 and reported as non-detect for five of the six samples collected from 2005 to 2006, with the exception being a 1 µg/L detection measured in 2006. RDX has been non-detect in the nine samples collected since April 2006.
- Upon approval of the proposed recommendations, a Project Note will be prepared in accordance with IAGWSP procedures documenting the recommended sample frequency changes.

7.5 Modeling

The relatively poor comparison between measured and predicted perchlorate and RDX concentrations suggest that further investigation, in the form of a drive-point contamination profile and monitoring well investigation, is necessary and should be provided as a project note. Additionally, following the review of drive-point profile data and sample collection from newly added monitoring wells, the perchlorate and RDX plume shells should be updated to improve the reliability of the model and its ability to accurately predict the spatial and temporal distribution of contaminant concentrations.

8.0 REFERENCES

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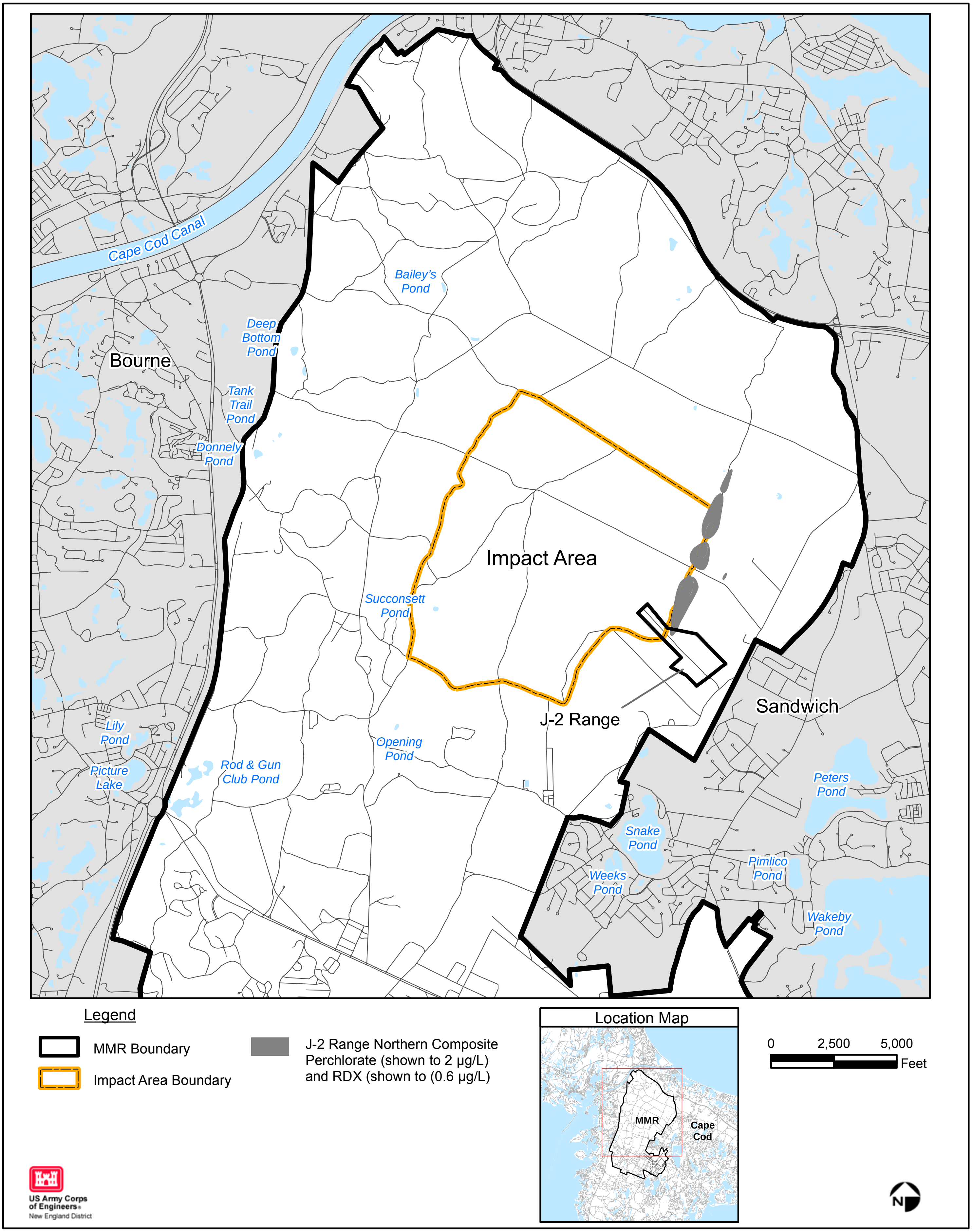
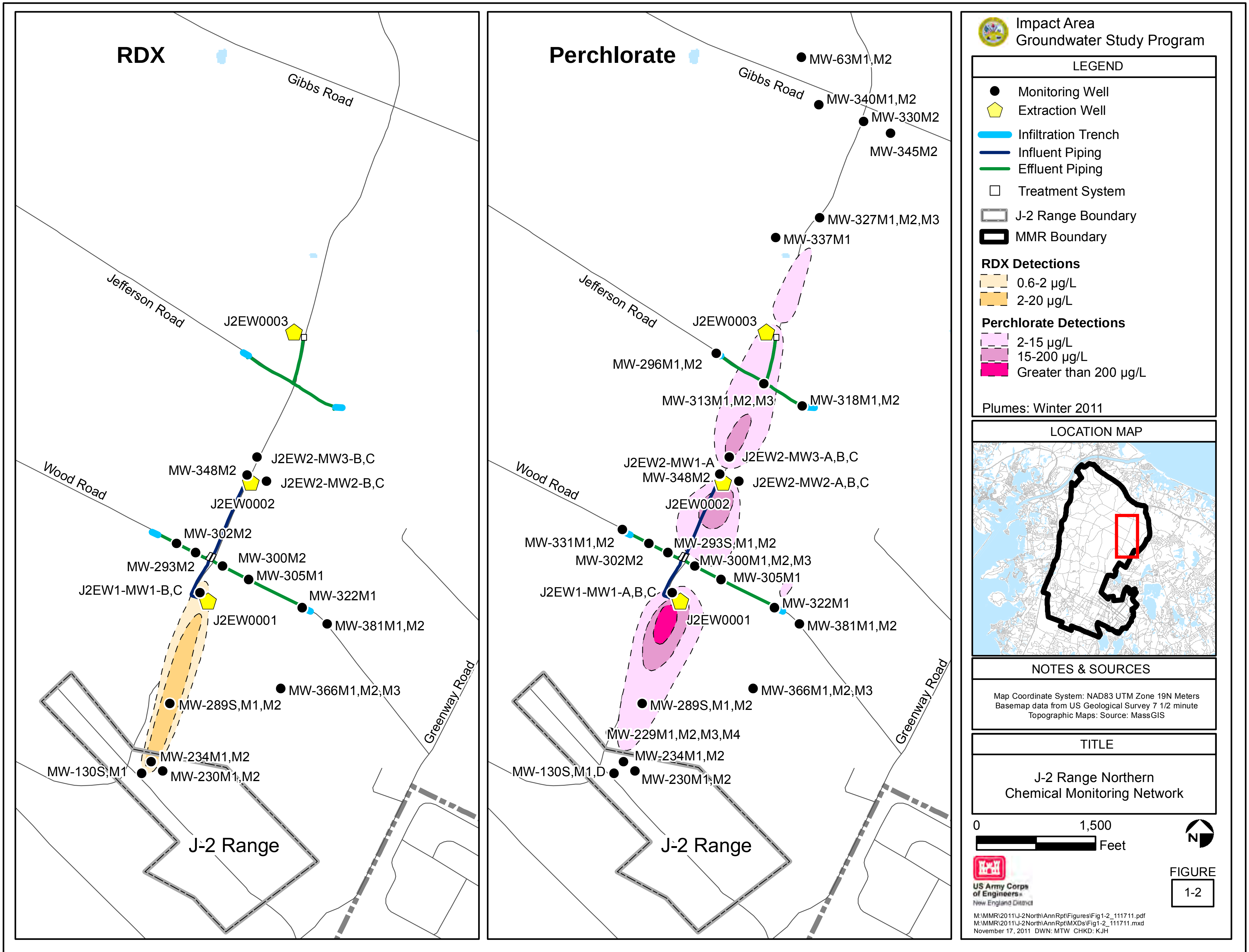
FIGURES



Location of J-2 Range

FIGURE 1-1



RDX
Gibbs Road
Jefferson Road
J2EW0003
J2EW2-MW3-B,C
MW-348M2
J2EW2-MW2-B,C
J2EW0002
Wood Road
MW-302M2
MW-300M2
MW-293M2
MW-305M1
J2EW1-MW1-B,C
MW-322M1
J2EW0001
MW-381M1,M2
MW-366M1,M2,M3
MW-289S,M1,M2
Greenway Road
MW-234M1,M2
MW-130S,M1
MW-230M1,M2
J-2 Range
Perchlorate
MW-63M1,M2
Gibbs Road
MW-340M1,M2
MW-330M2
MW-345M2
MW-327M1,M2,M3
MW-337M1
Jefferson Road
J2EW0003
MW-296M1,M2
MW-313M1,M2,M3
MW-318M1,M2
J2EW2-MW1-A
J2EW2-MW3-A,B,C
MW-348M2
J2EW2-MW2-A,B,C
J2EW0002
Wood Road
MW-331M1,M2
MW-293S,M1,M2
MW-302M2
MW-300M1,M2,M3
MW-305M1
J2EW1-MW1-A,B,C
MW-322M1
J2EW0001
MW-381M1,M2
MW-366M1,M2,M3
MW-289S,M1,M2
Greenway Road
MW-229M1,M2,M3,M4
MW-234M1,M2
MW-130S,M1,D
MW-230M1,M2
J-2 Range
Impact Area
Groundwater Study Program
LEGEND
Monitoring Well
Extraction Well
Infiltration Trench
Influent Piping
Effluent Piping
Treatment System
J-2 Range Boundary
MMR Boundary
RDX Detections
0.6-2 µg/L
2-20 µg/L
Perchlorate Detections
2-15 µg/L
15-200 µg/L
Greater than 200 µg/L
Plumes: Winter 2011
LOCATION MAP
NOTES & SOURCES
Map Coordinate System: NAD83 UTM Zone 19N Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Maps: Source: MassGIS
TITLE
J-2 Range Northern
Chemical Monitoring Network
0
1,500
Feet
N
US Army Corps
of Engineers
New England District
FIGURE
1-2
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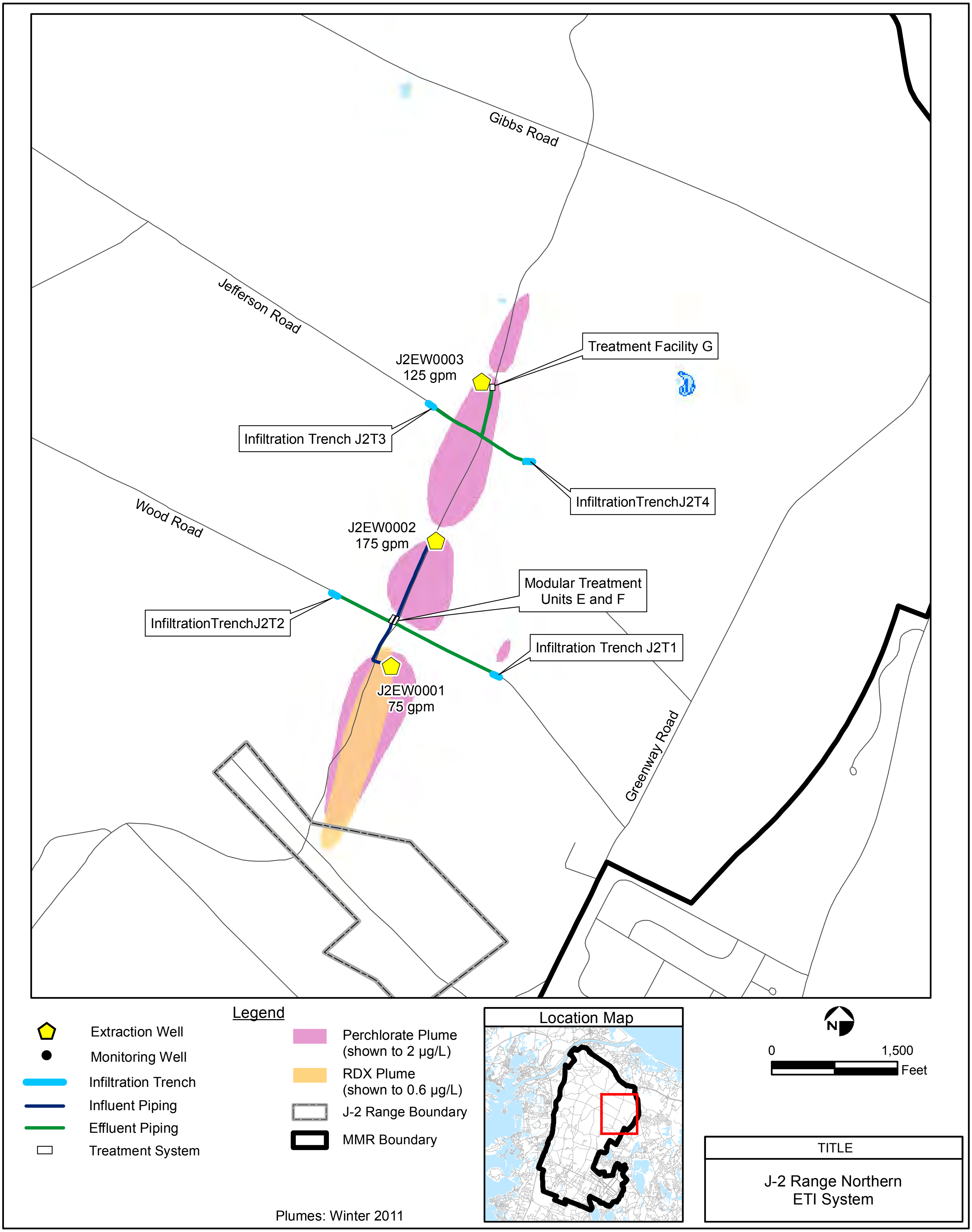
November 17, 2011 DWN: MTW CHKD: KJH



TITLE

J-2 Range Northern
ETI System

US Army Corps of Engineers
New England District

Impact Area
Groundwater Study Program

FIGURE
2-1

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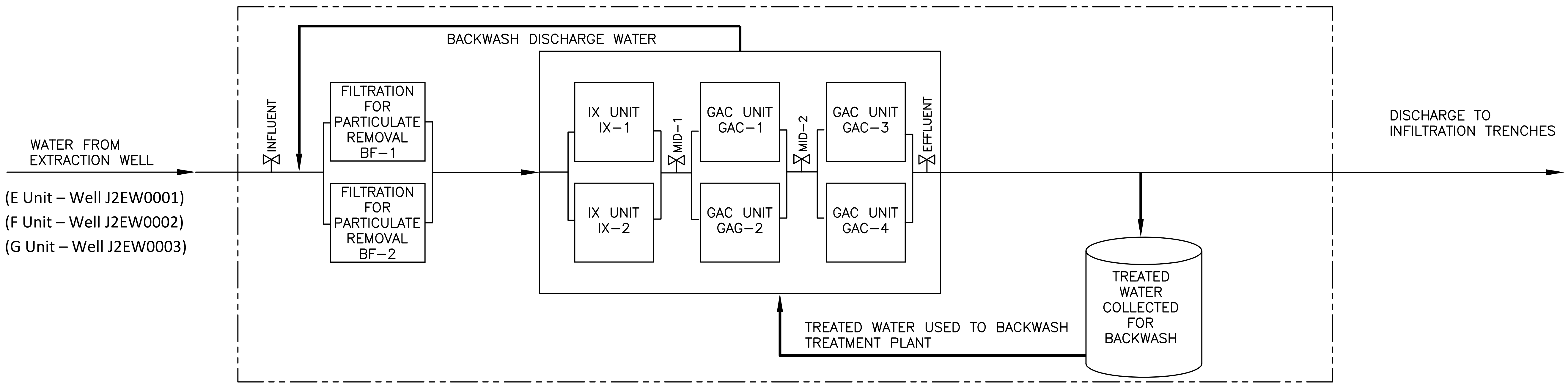


Systems for Modular
Units E and F and
Treatment Plant G

SAMPLING LOCATIONS

INFLUENT	INFLUENT SAMPLE LOCATIONS	PERCHLORATE AND EXPLOSIVES
MID−1	PRIMARY MIDFLUENT LOCATIONS	PERCHLORATE
MID−2	SECONDARY MIDFLUENT SAMPLE LOCATIONS	EXPLOSIVES
EFFLUENT	EFFLUENT SAMPLE LOCATIONS	PERCHLORATE AND EXPLOSIVES

LEGEND:

− TREATMENT PLANT THROUGH FLOW
− TREATMENT PLANT PERIPHERAL FLOW
− SAMPLE PORT

J-2 Range Northern
Modular Treatment Unit for Systems E and F
And Treatment Plant G
Process Flow Diagram

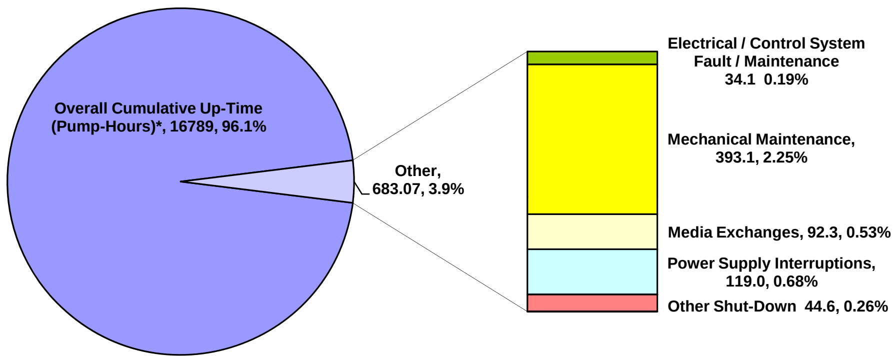
Date: 12/23/2010

2-2

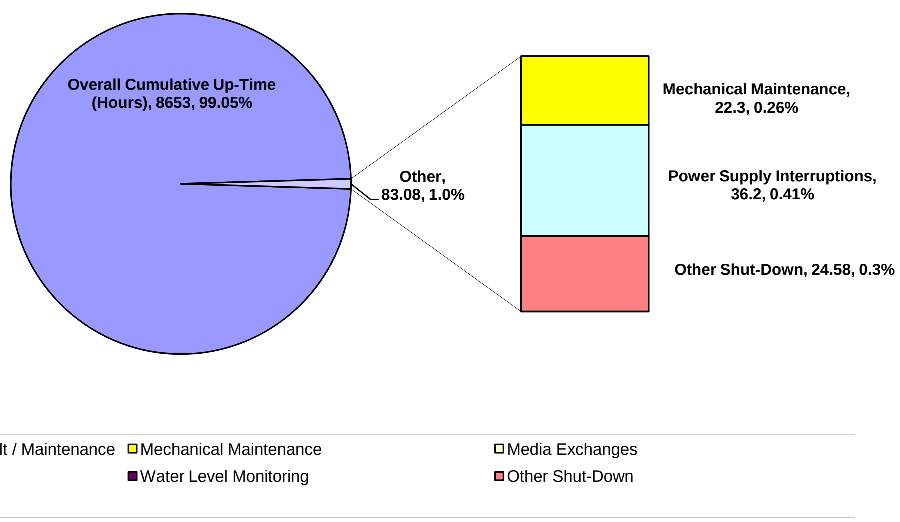
Xref TITLE−J2E−B.dwg

Figure 2-3
Downtime by Category
J-2 Range Northern GW RRA Systems
August 2010 through July 2011

a) J-2 Range Northern GW RRA Units E&F



b) J-2 Range Northern GW RRA Unit G



*Note: Units E&F, the Wood Road treatment system, are fed by two extraction wells. There are times when one well is off due to some maintenance issue, but the other pump remains “up” and continues pumping from the other extraction well. Thus, up-time (and downtime) for this system is characterized by pump hours. There were 2 x 8736 possible pump hours during this reporting period.

Figure 3-1
Influent Contaminant Concentration
J-2 Range Northern Mobile Treatment Units E & F

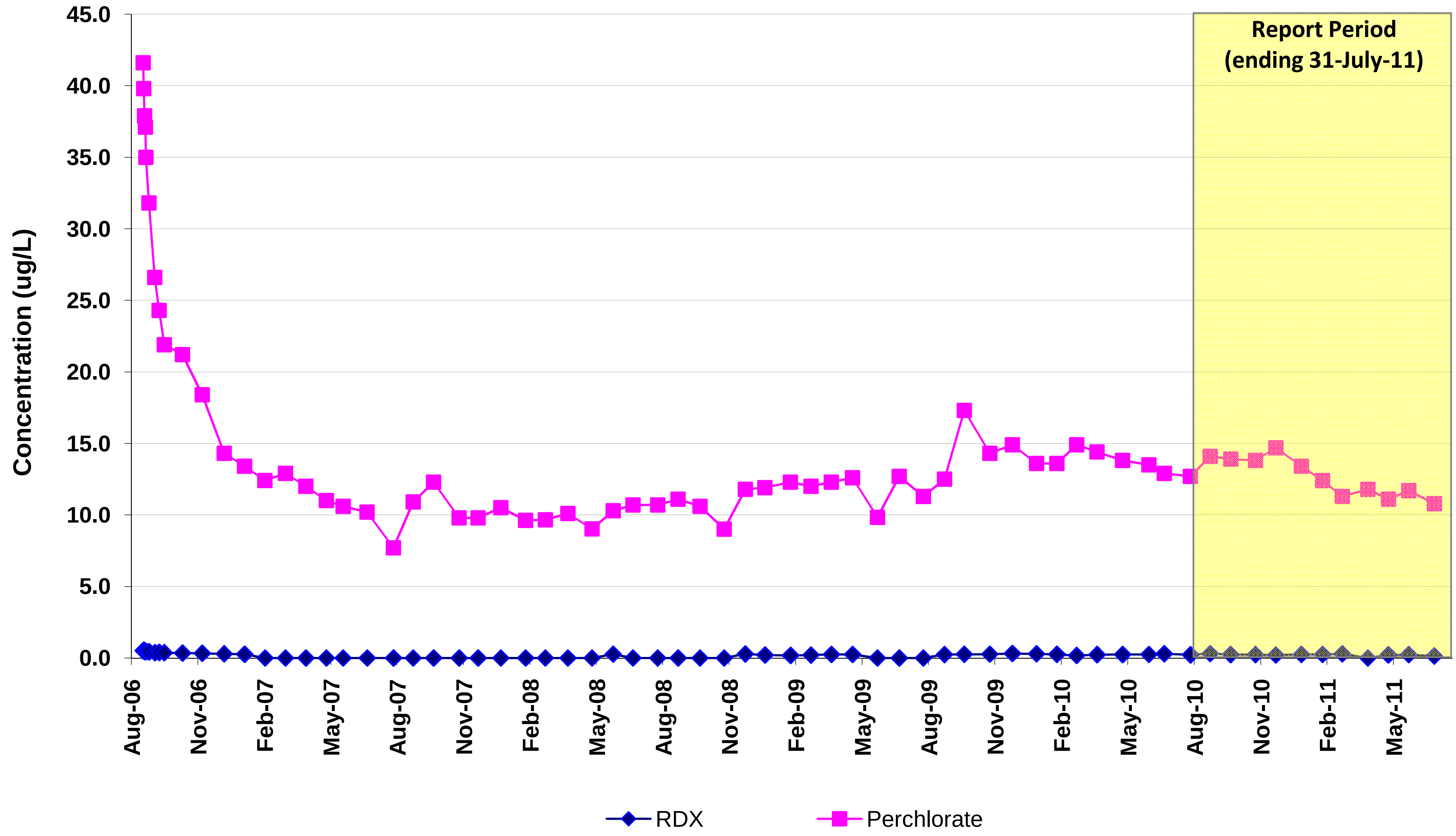


Figure 3-2
Total Groundwater Volume Treated Since Startup
J-2 Range Northern Mobile Treatment Units E & F

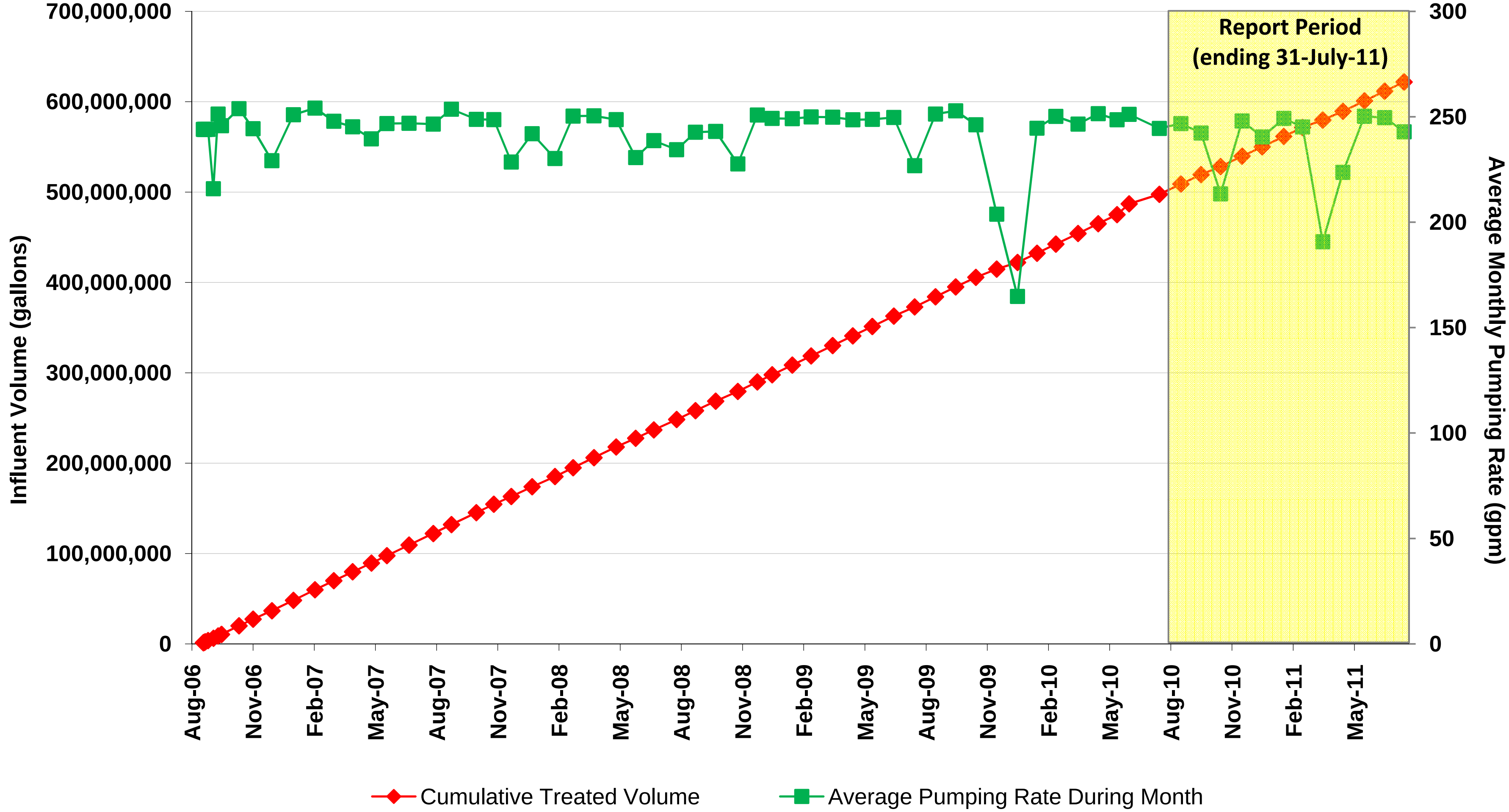


Figure 3-3
Contaminant Mass Removal
J-2 Range Northern Mobile Treatment Units E & F

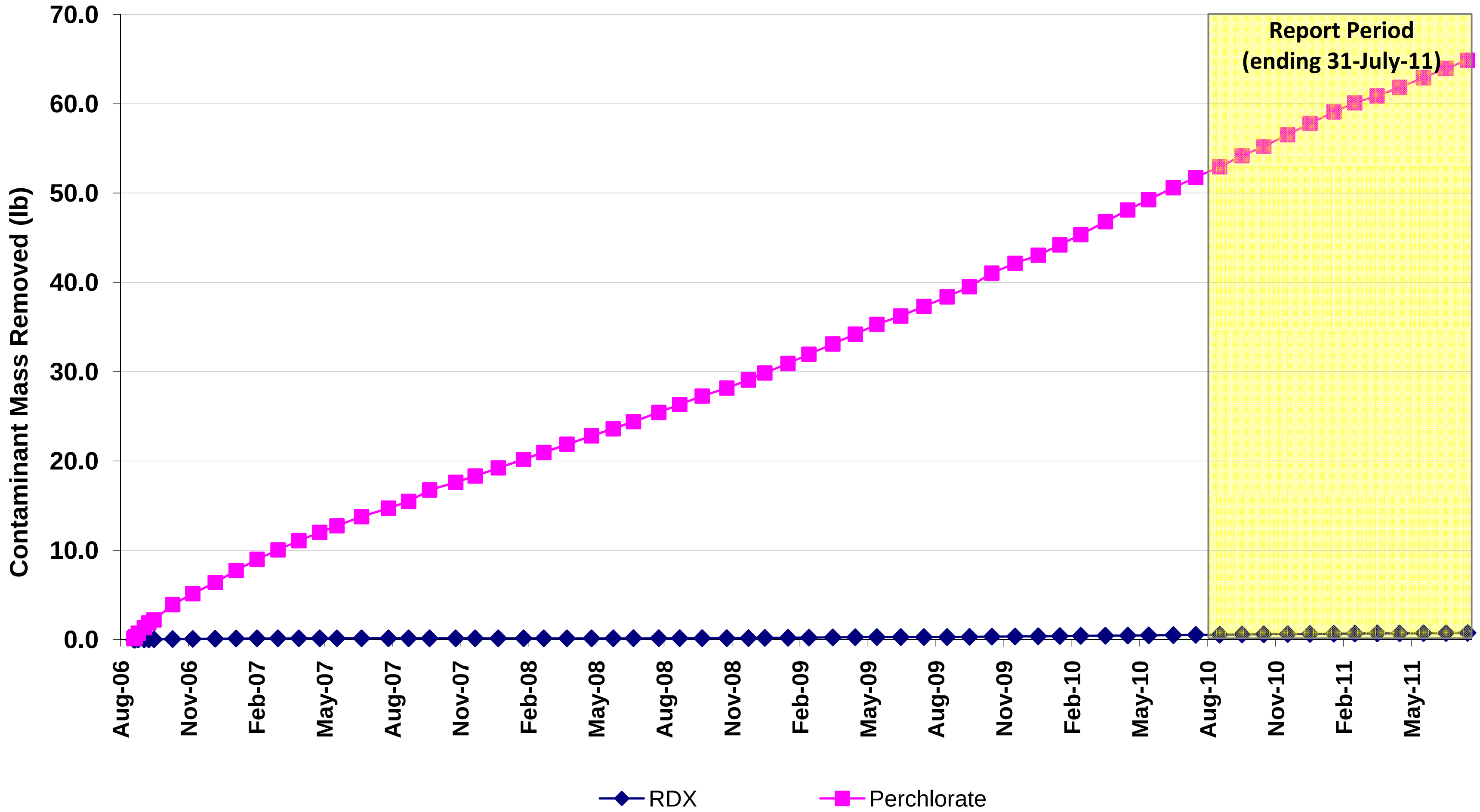


Figure 3-4
Influent Contaminant Concentrations
J-2 Range Northern Treatment Facility G

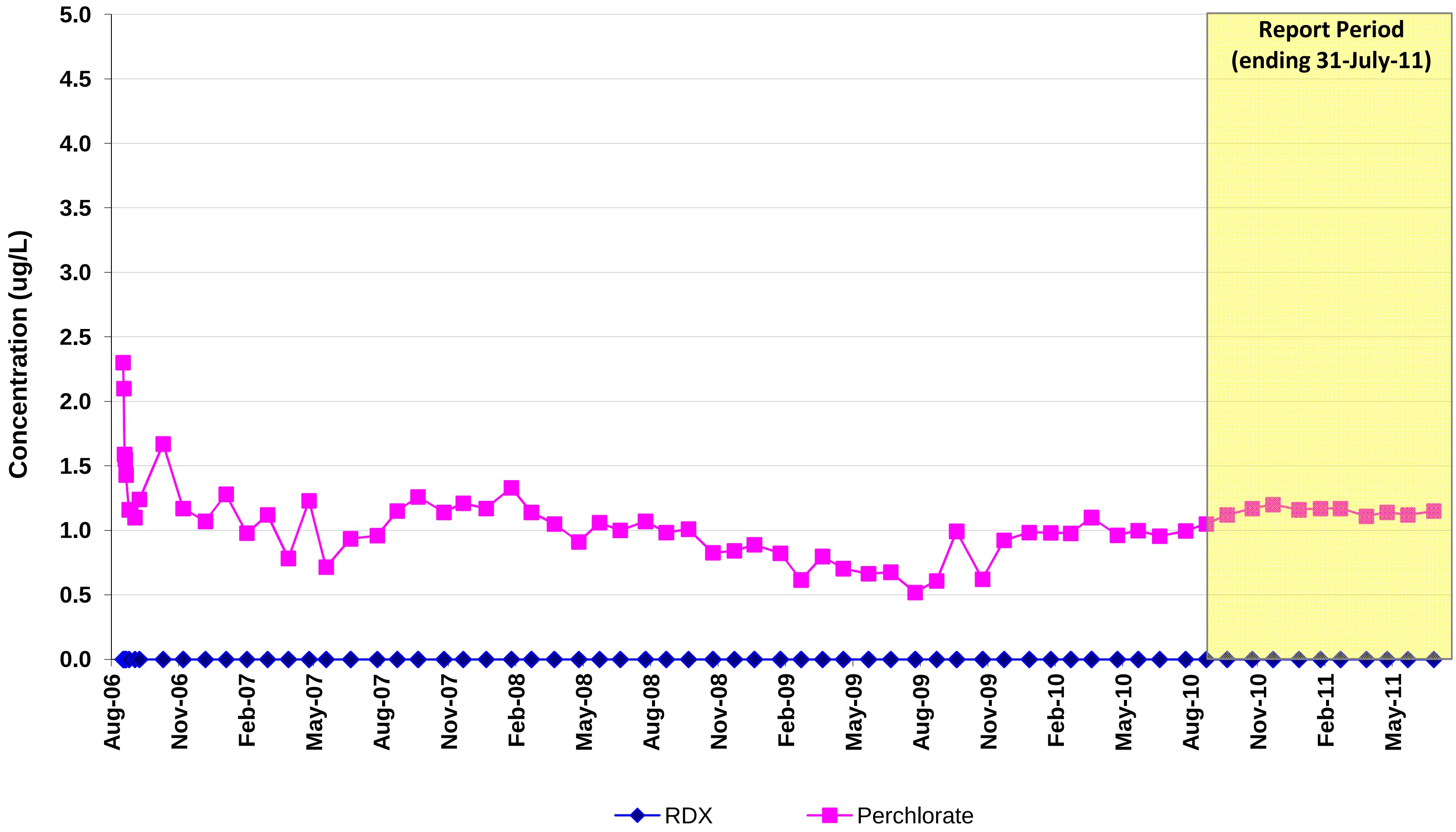


Figure 3-5
Total Groundwater Volume Treated Since Startup
J-2 Range Northern Treatment Facility G

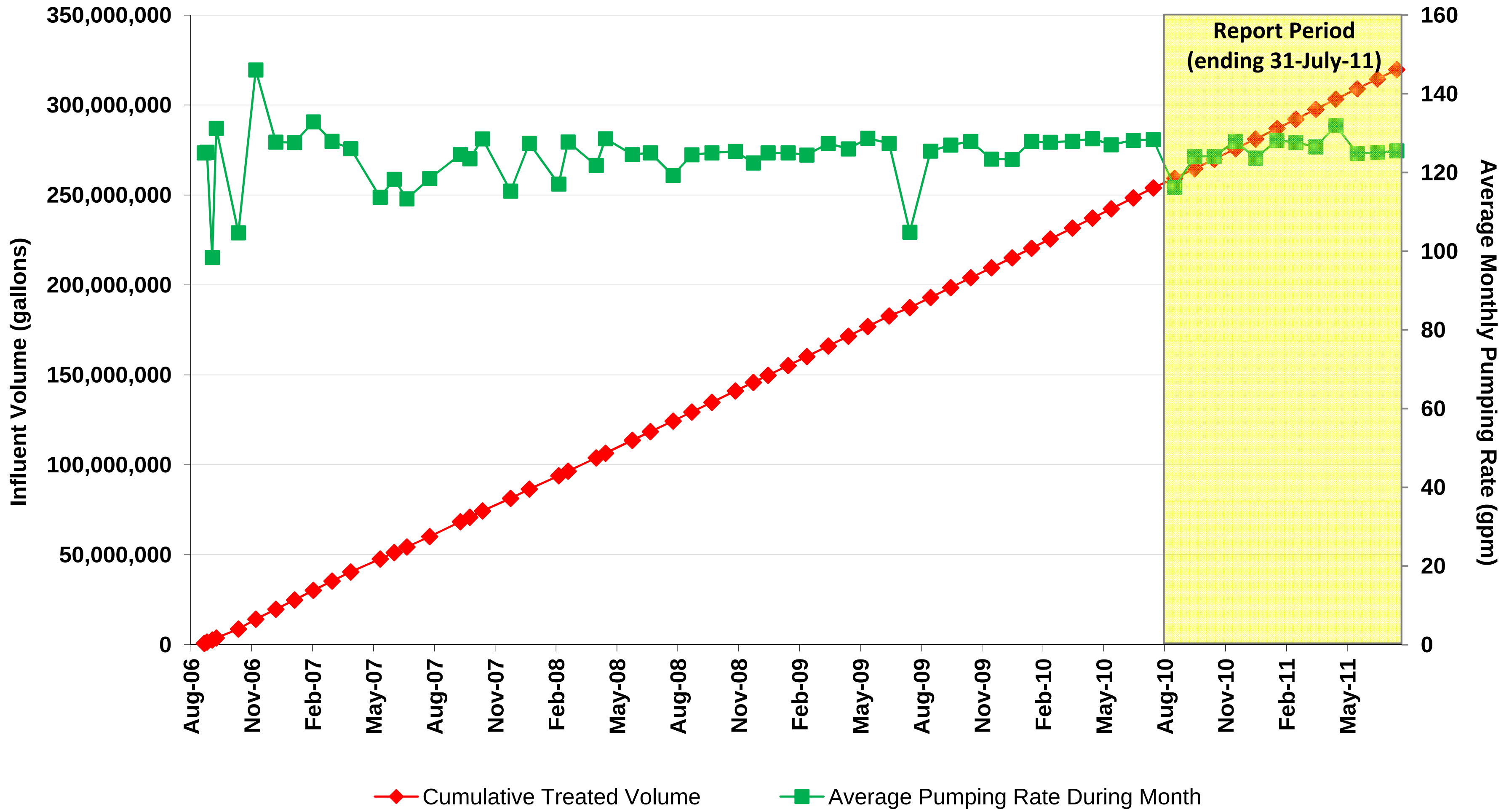
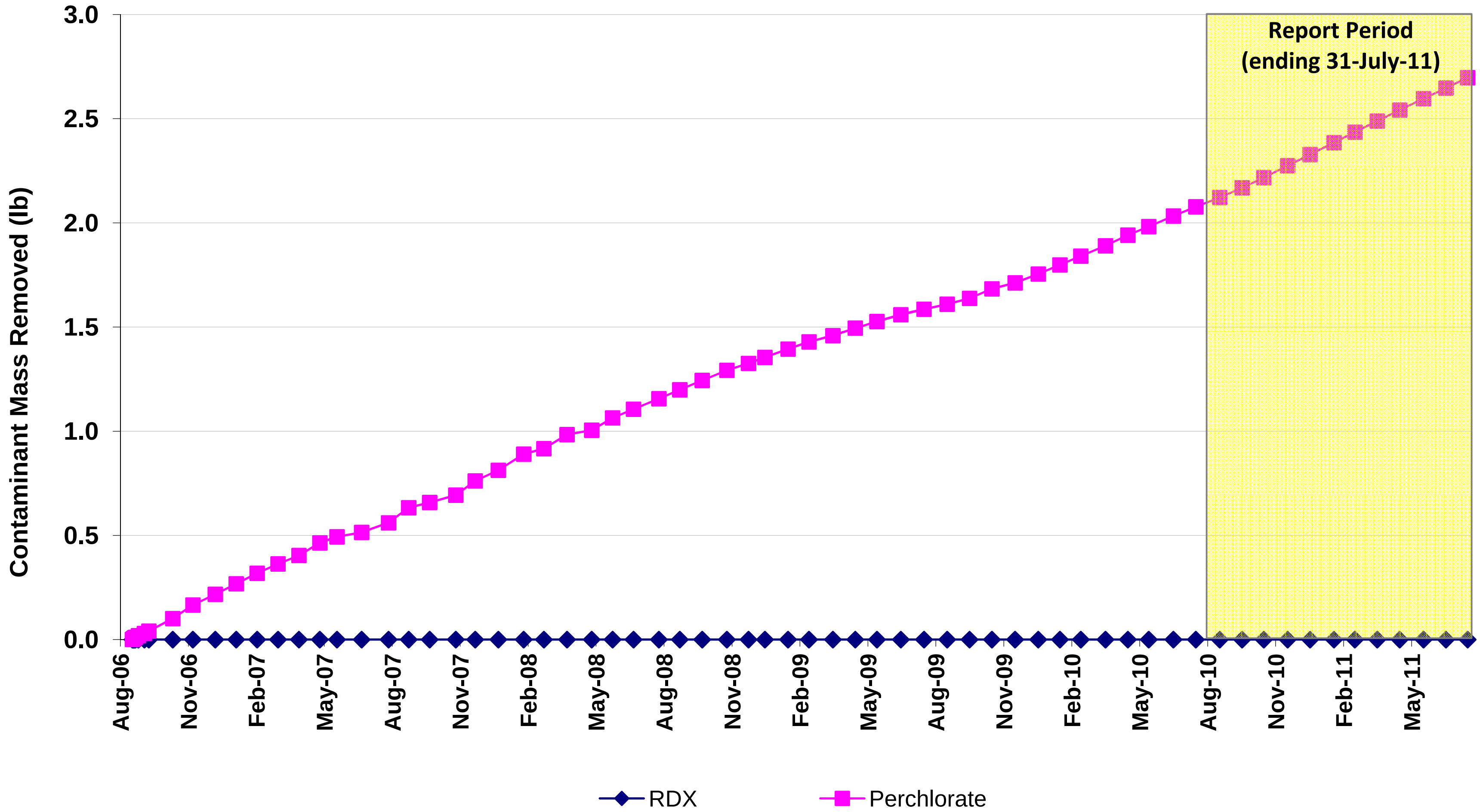
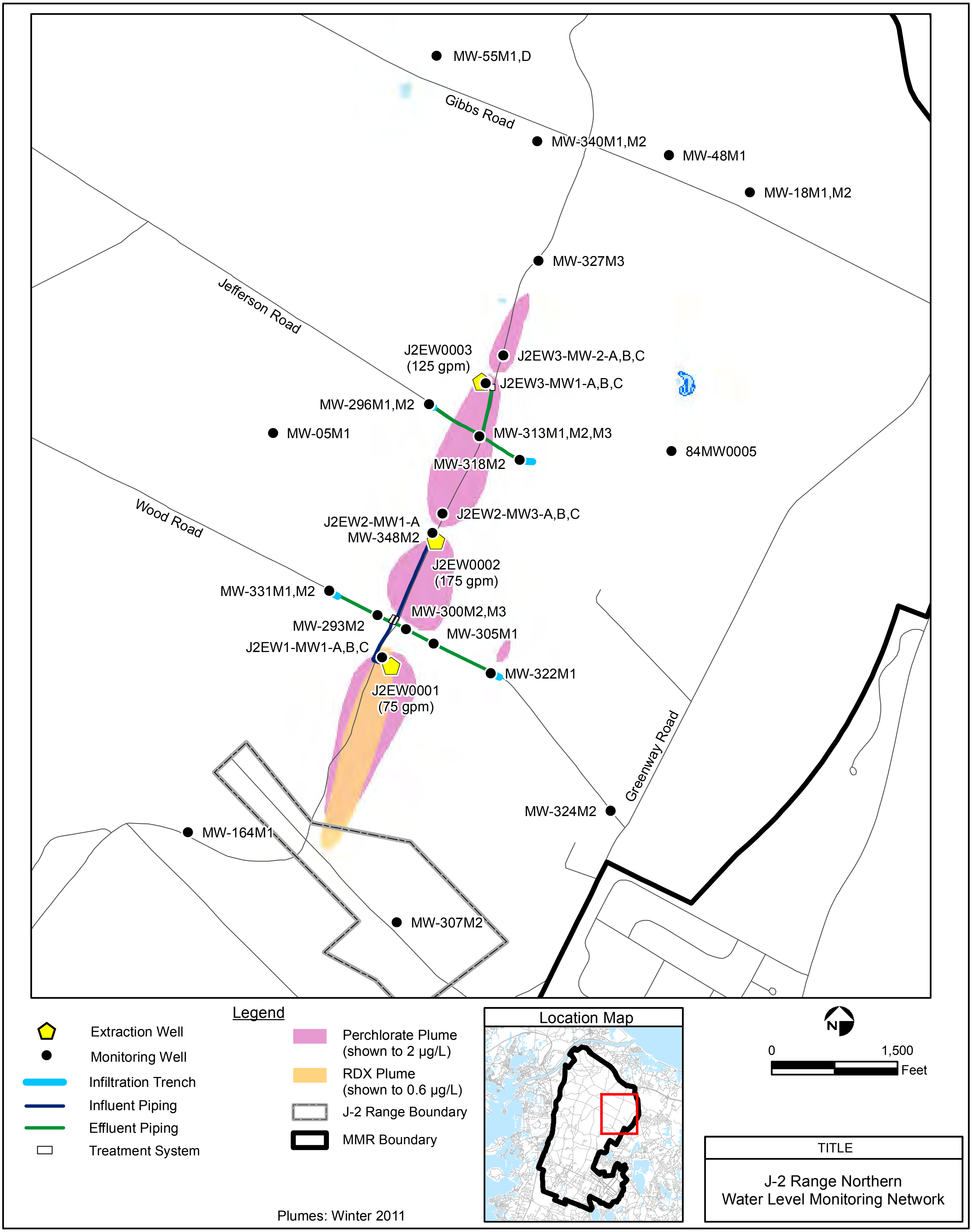


Figure 3-6
Contaminant Mass Removal
J-2 Range Northern Treatment Facility G





TITLE

J-2 Range Northern
Water Level Monitoring Network

US Army Corps of Engineers
New England District

Impact Area
Groundwater Study Program

FIGURE
4-1

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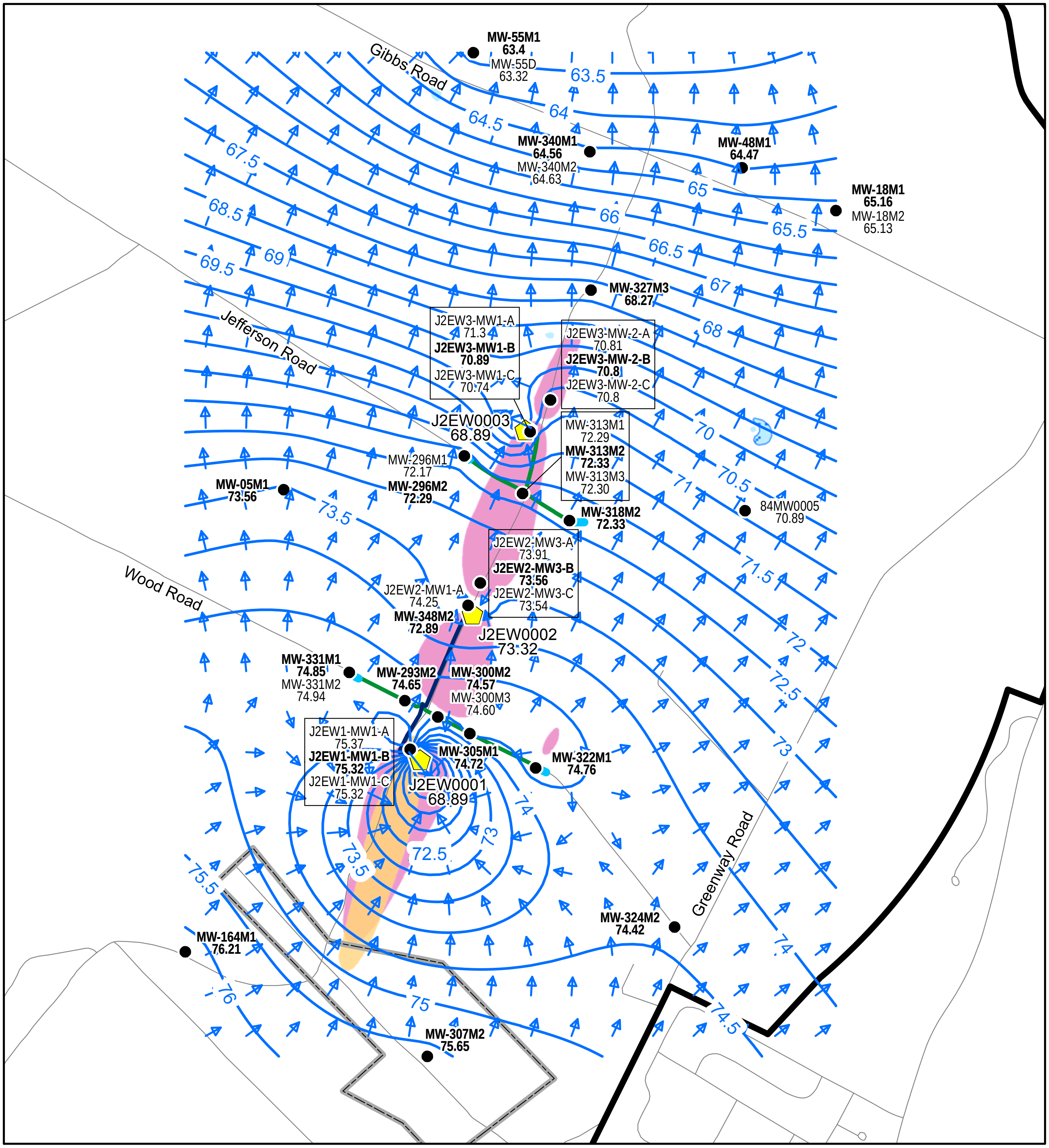
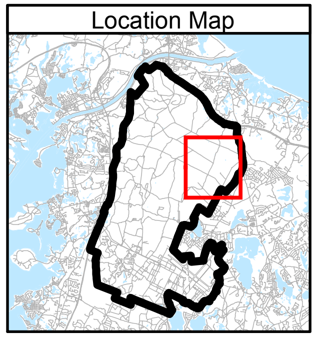


Legend

- Extraction Well
- Monitoring Well
- Infiltration Trench
- Influent Piping
- Effluent Piping
- Treatment System
- 73.5 Potentiometric Contours, 0.5 foot mean sea level intervals
- Perchlorate Plume (shown to 2 µg/L)
- RDX Plume (shown to 0.6 µg/L)
- J-2 Range Boundary
- MMR Boundary

Perchlorate Plume: Winter 2011
RDX Plume: Fall 2010

Location Map



N

0 1,500 Feet

TITLE

J-2 Range Northern Groundwater Potentiometric Map for 23 August 2010

US Army Corps of Engineers
New England District

Impact Area Groundwater Study Program

FIGURE 4-2

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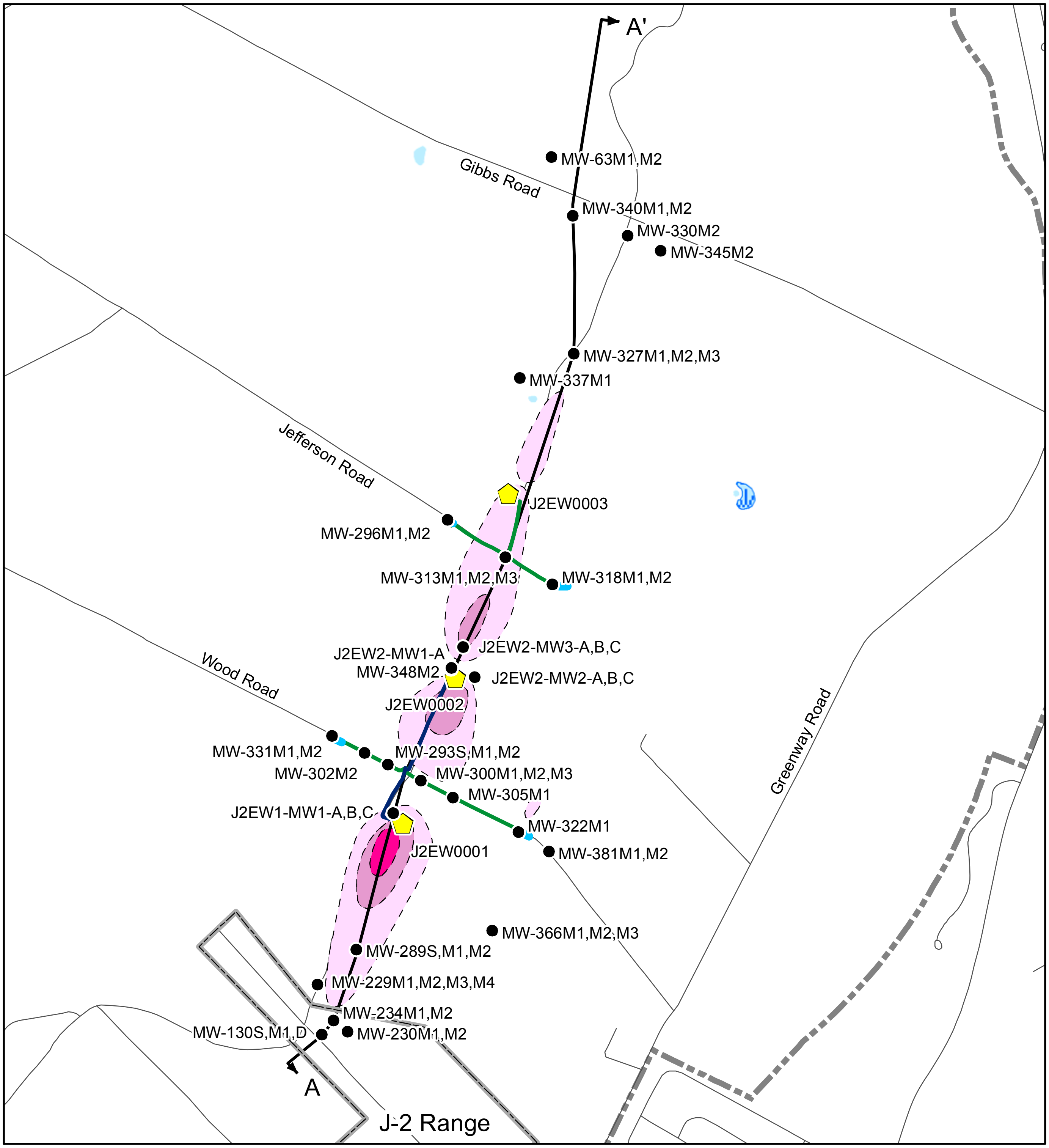


Legend

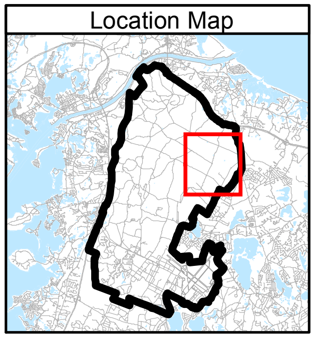
- Monitoring Well
- Extraction Well
- Infiltration Trench
- Influent Piping
- Effluent Piping

Perchlorate Detections

- 2-15 µg/L
- 15-200 µg/L
- Greater than 200 µg/L
- J-2 Range Boundary
- MMR Boundary

Plume: Winter 2011

Location Map



N

0 1,500 Feet

TITLE

J-2 Range Northern Plume
Perchlorate Distribution and
Lines of Cross Section Location

US Army Corps of Engineers
New England District

Impact Area
Groundwater Study Program

FIGURE 5-1

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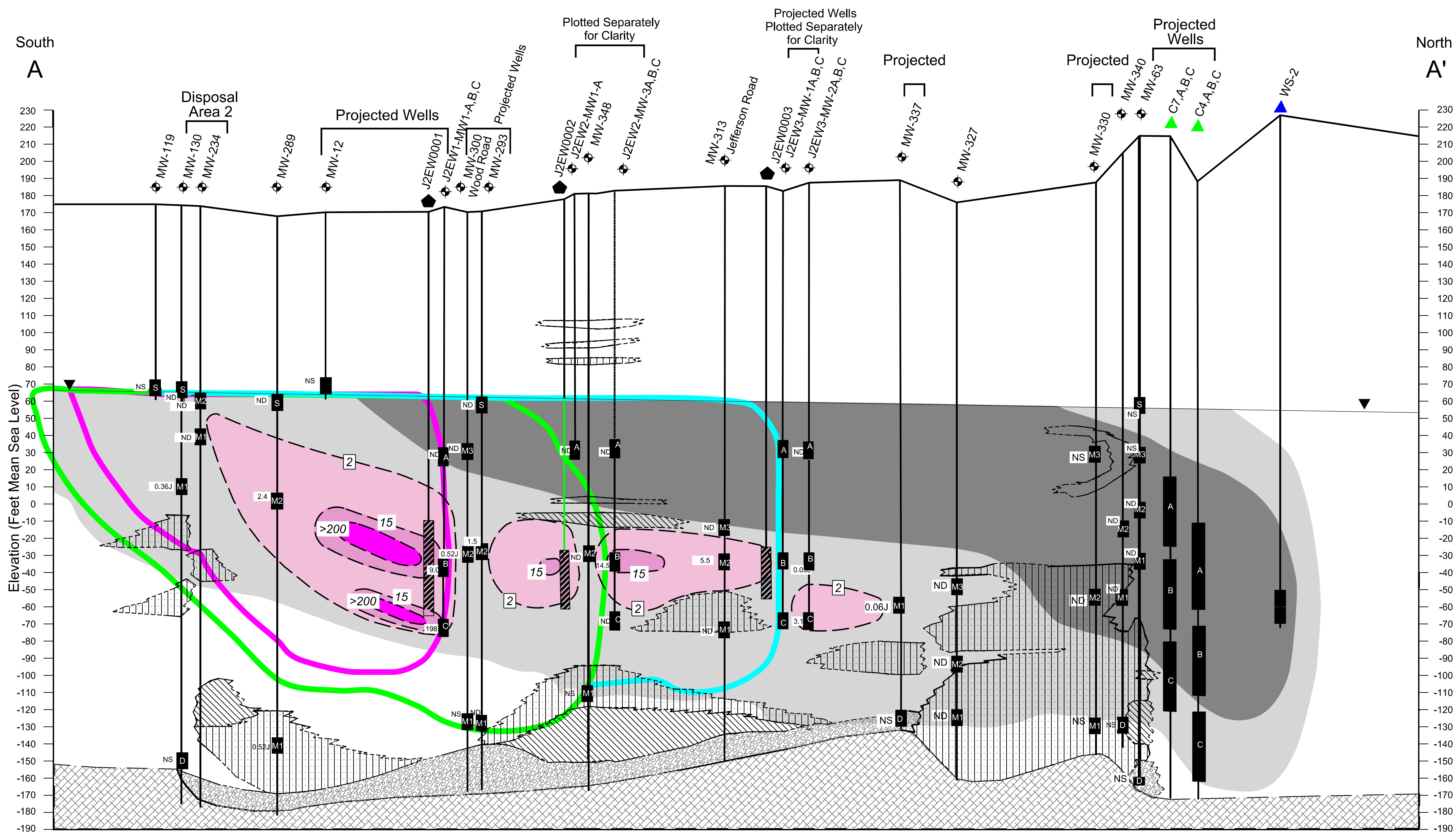


Legend

- Monitoring Well
- Extraction Well
- Water Supply Sentry Well
- Water Supply Well
- Water table
- M1 Well screen ID
- Extraction Well Screen

J	Estimated Concentration
ND	Nondetect
µg/L	Micrograms per liter
NS	Not Sampled

Note: Validated monitoring well results shown to left of well screen ID.

- Sand
- Silt/Clay
- Sand and Silt/Clay
- Basal Gravel/Sand
- Bedrock

J-2 Range North Plume

- 2-15 µg/L
- 15-200 µg/L
- Greater than 200 µg/L

- Vertical Capture Zone for J2ew0001 2010 Operational Conditions
- Vertical Capture Zone for J2ew0002 2010 Operational Conditions
- Vertical Capture Zone for J2ew0003 2010 Operational Conditions

Database. Water level from 2003 Synoptic Event.

Zone of Contribution (Model Run 13)
Water Supply Well WS-2 (looking west)

- Average Operating Flow Rates
- One Million Gallons/Day

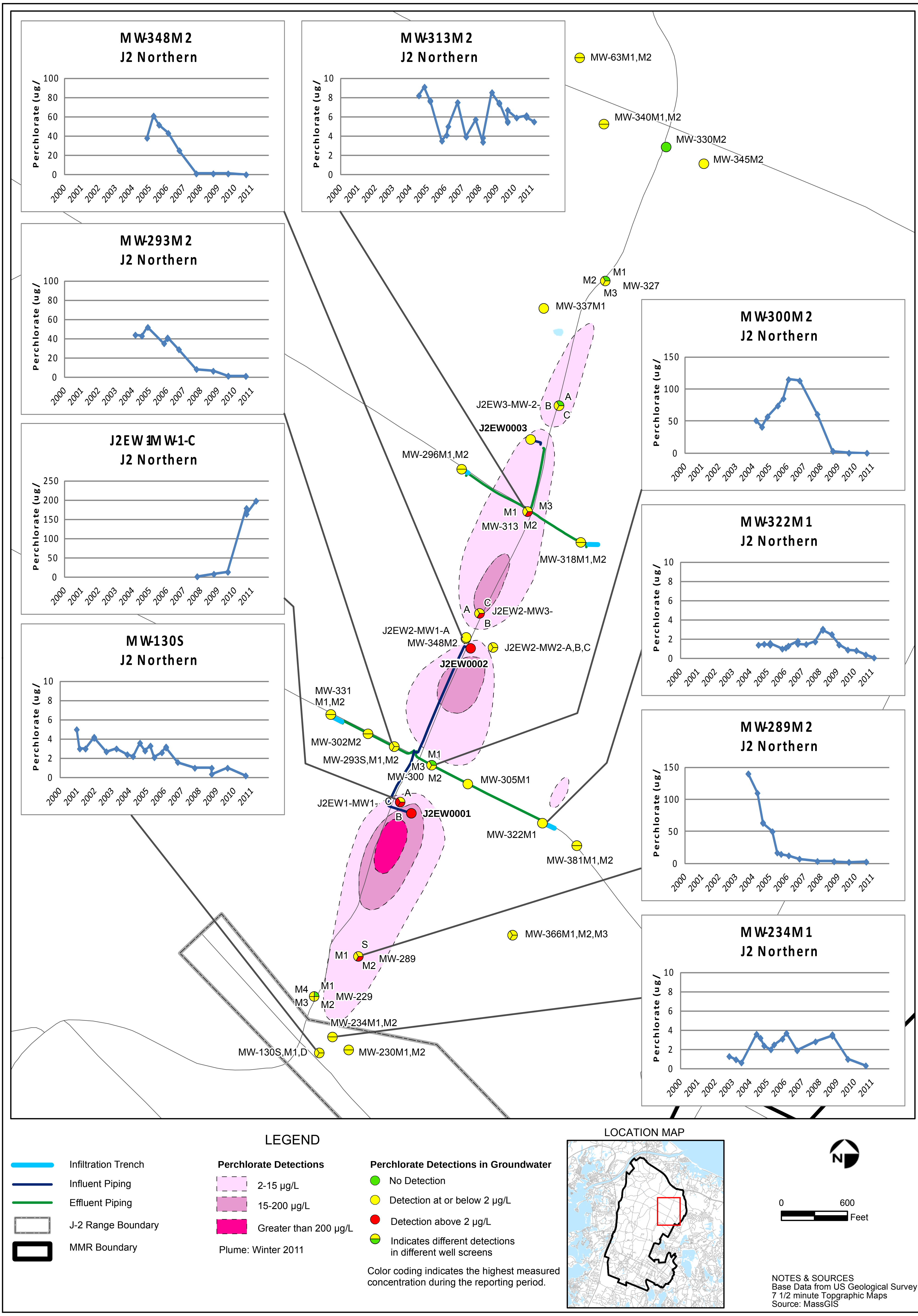
— Geologic Contact (dashed where inferred)

V:60
H:1000
0
Scale in Feet

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

MASSACHUSETTS MILITARY RESERVATION
CAPE COD. MASSACHUSETTS
IMPACT AREA GROUNDWATER
STUDY PROGRAM
J-2 RANGE
NORTH PLUME CROSS SECTION A-A'
ILLUSTRATING PERCHLORATE DISTRIBUTIONS

DATE: 01/06/2012 PLOT SCALE: 1"=60'-0"	FILE NAME: J2N_PER_AA_Fig5-2-010612.dgn	FIGURE 5-2



US Army Corps of Engineers
New England District

Impact Area Groundwater Study Program

J-2 Northern Range Groundwater Perchlorate Trends

FIGURE 5-3

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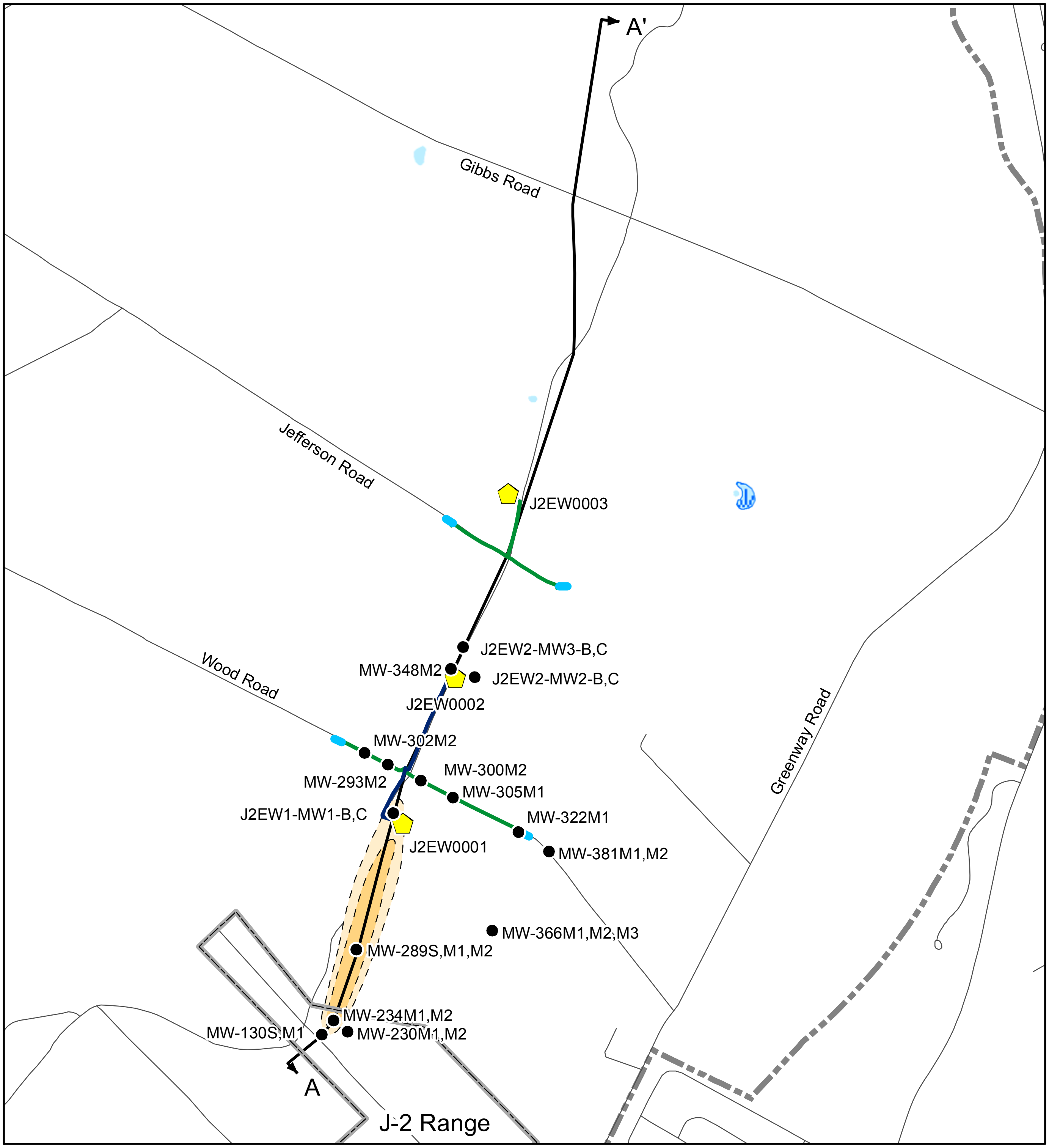
May 24, 2012 DWN: MTW CHKD: KJH



Legend

- Monitoring Well
- Extraction Well
- Infiltration Trench
- Influent Piping
- Effluent Piping

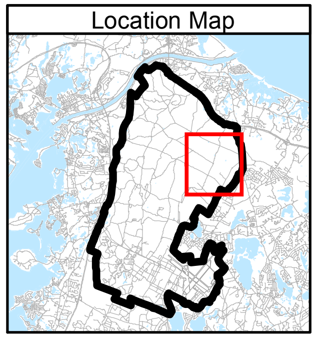
RDX Detections

- 0.6-2 µg/L
- 2-20 µg/L

- J-2 Range Boundary
- MMR Boundary

Plume: Fall 2010

Location Map



N

0 1,500 Feet

TITLE

J-2 Range Northern Plume
RDX Distribution and
Lines of Cross Section Location

US Army Corps of Engineers
New England District

Impact Area
Groundwater Study Program

FIGURE
5-4

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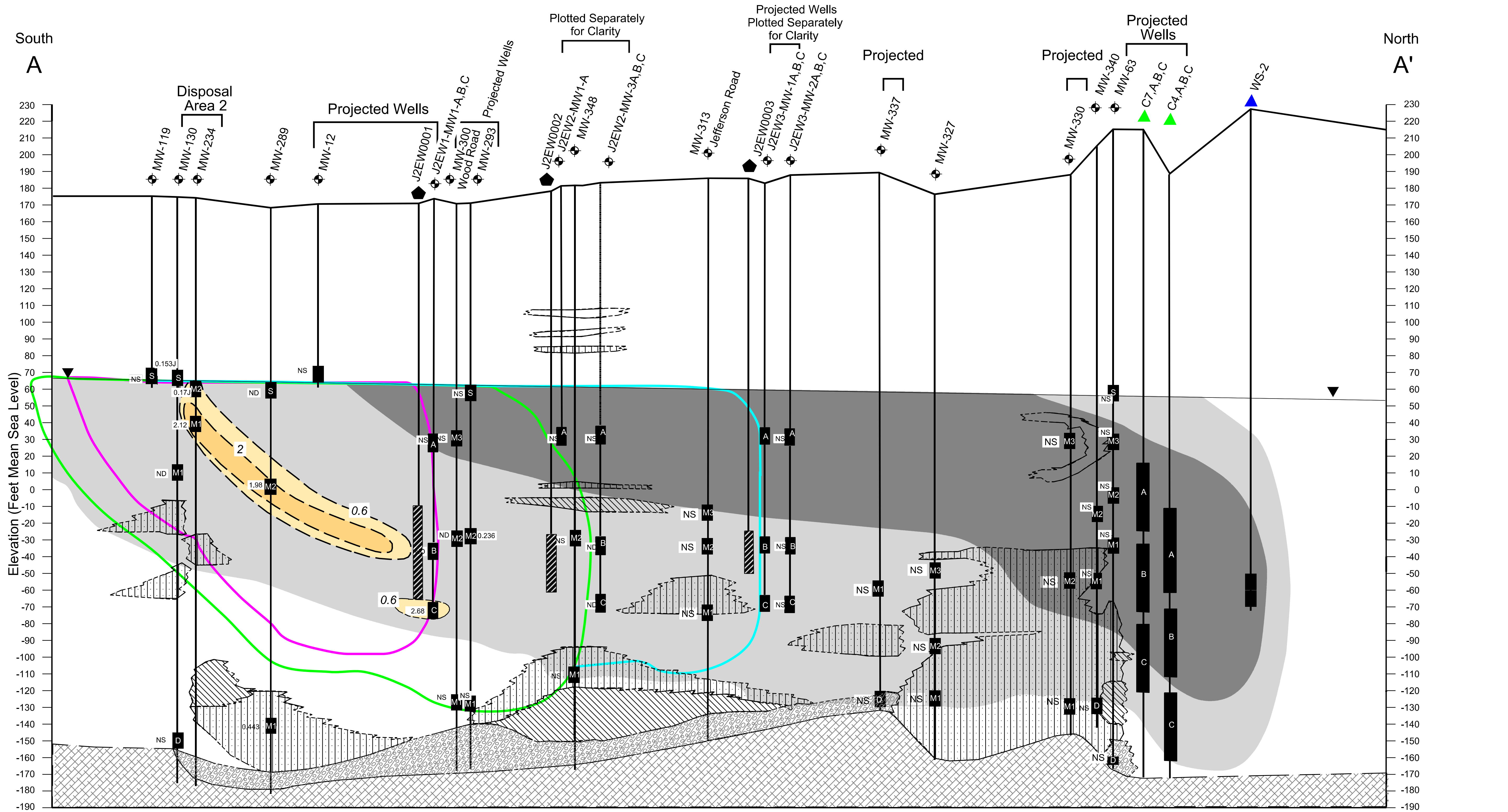
M:\MMR\2011\J-2North\AnnRpt\MXDs\Fig5-4_121311.mxd
December 13, 2011 DWN: MTW CHKD: KJH



Legend

Extraction Well	Sand	NS	Not Sampled	0.6-2 µg/L	Vertical Capture Zone for J3EWIP1 2011 Operational Conditions
Monitoring Well	Silt/ Clay	J	Estimated Concentration	2-20 µg/L	Vertical Capture Zone for J3EW0032 2011 Operational Conditions
Water table	Sand and Silt/Clay	ND	Nondetect	20-200 µg/L	Vertical Capture Zone for 90ew0001 2011 Operational Conditions
Well screen ID	Basal Gravel/Sand	µg/L	Micrograms per liter		
Extraction Well Screen	Bedrock	NGVD	National Geodetic Vertical Datum		

Geologic Contact (dashed where inferred)

Note: The most downgradient lobe is projected from the west of the cross section.

Data Source: IAGWSP EDMS Database, Water level from 2003 Synoptic Event.

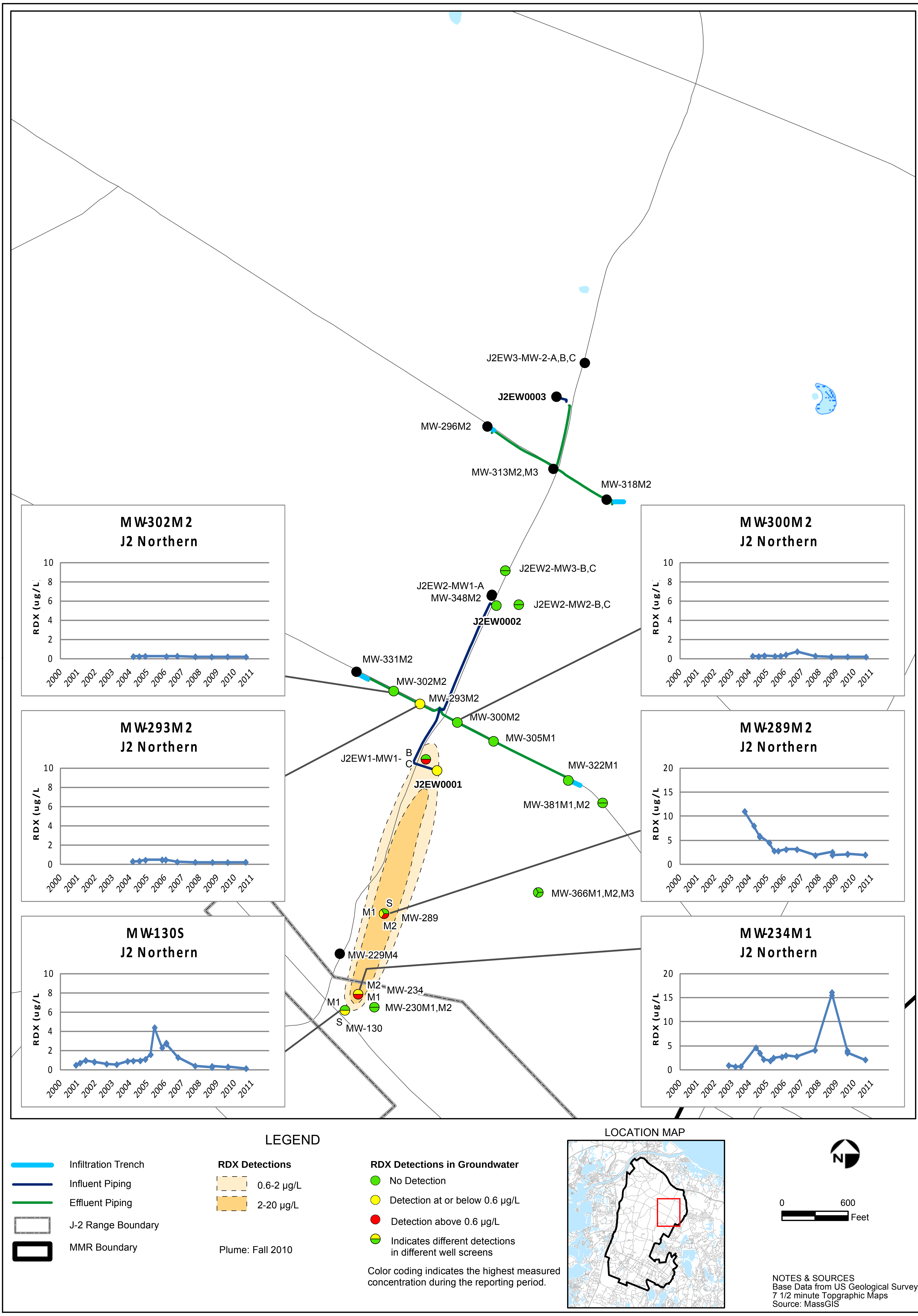
HORIZONTAL SCALE: 1"=500'
0' 250' 500'

0' 30' 60'
VERTICAL SCALE: 1"=60'

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

MASSACHUSETTS MILITARY RESERVATION
CAPE COD. MASSACHUSETTS
IMPACT AREA GROUNDWATER
STUDY PROGRAM
J-2 RANGE NORTHERN
PLUME CROSS SECTION A-A'
RDX DISTRIBUTION IN
GROUNDWATER FROM AUGUST 2010 AND FEBRUARY 2011

DATE: 05/25/2012
PLOT SCALE: 1"=60'-0"
FILE NAME: J2N_RDX_AA_Fig5-5_05-25-12.DGN
FIGURE 5-5



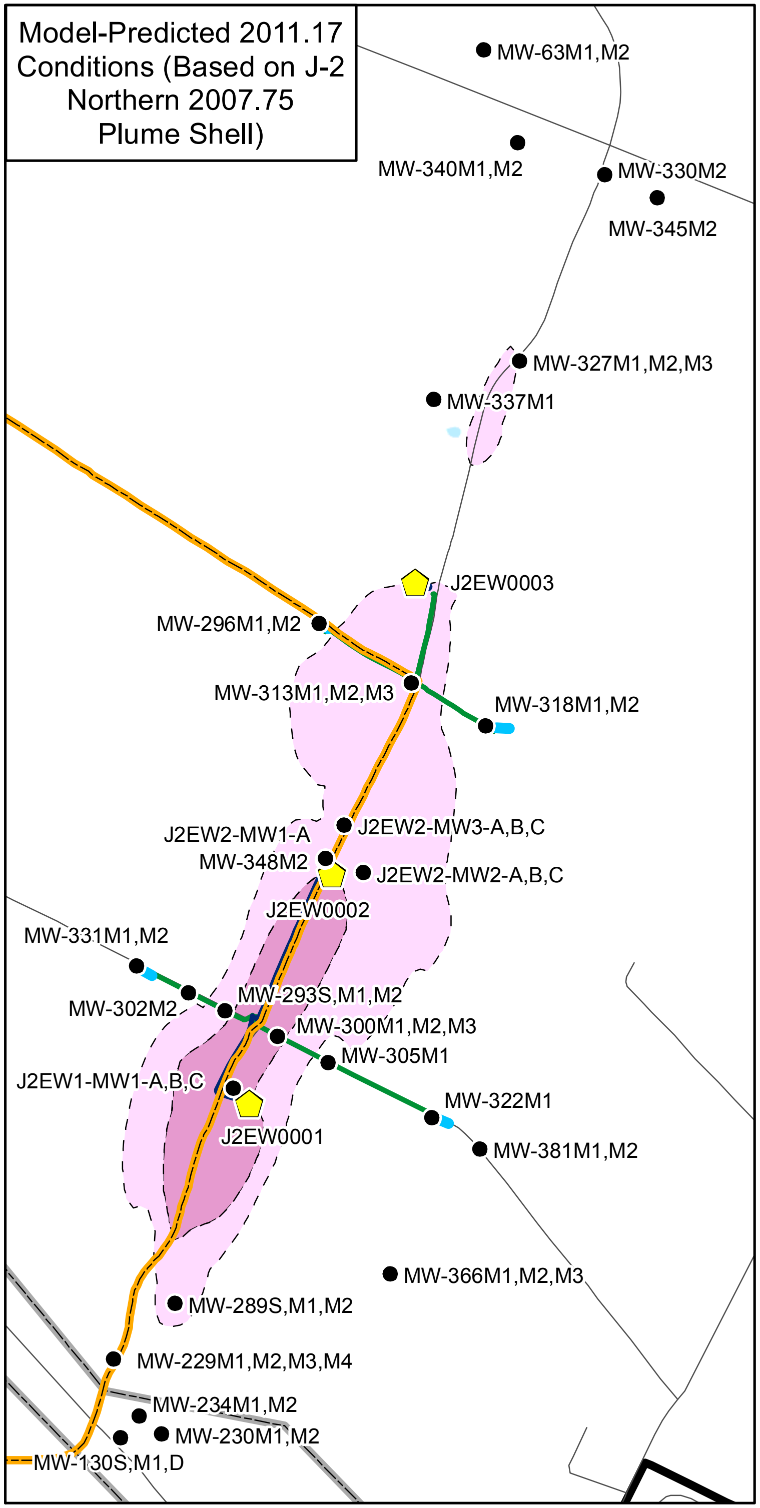
US Army Corps of Engineers
New England District

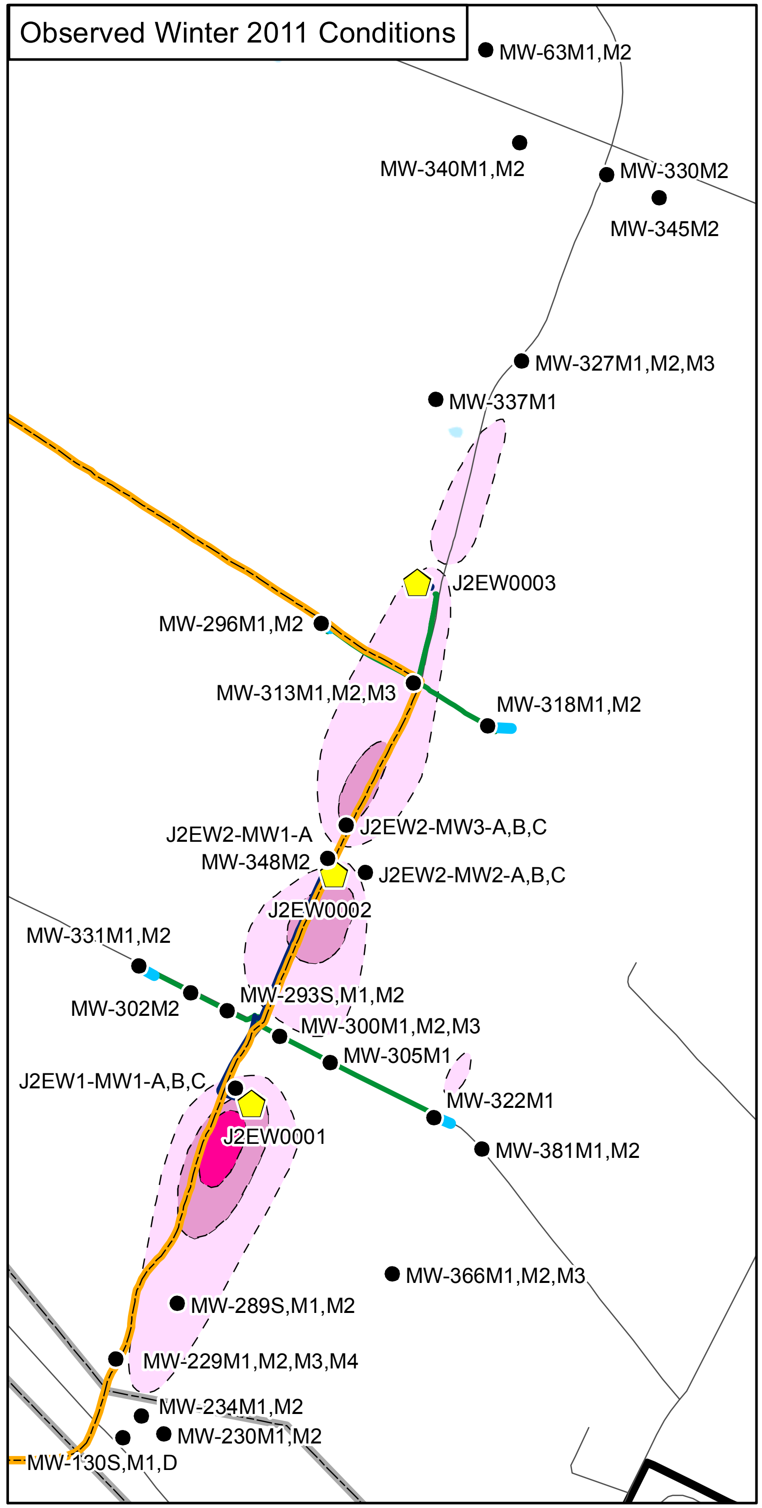
Impact Area Groundwater Study Program

J-2 Northern Range Groundwater RDX Trends

FIGURE 5-6

M:\MMR\2011\J-2North\AnnRpt\Figures\Fig5-6_052412.pdf
M:\MMR\2011\J-2North\AnnRpt\MXDs\Fig5-6_052112.mxd
May 24, 2012 DWN: MTW CHKD: KJH





Impact Area Groundwater Study Program

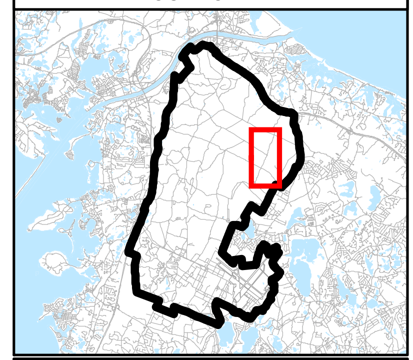
LEGEND

- Monitoring Well
- Extraction Well
- J-2 Range Boundary
- MMR Boundary

Perchlorate Detections

- 2-15 μg/L
- 15-200 μg/L
- Greater than 200 μg/L

LOCATION MAP



NOTES & SOURCES

Map Coordinate System: NAD83 UTM Zone 19N Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Maps: Source: MassGIS

TITLE

J-2 Range Northern Model-Predicted and Observed Perchlorate Distribution

0 1,500 Feet

N

US Army Corps of Engineers
New England District

FIGURE 6-1

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November 17, 2011 DWN: MTW CHKD: KJH

Figure 6-2

J-2 Range Northern Model Predicted and Observed Extracted Groundwater Concentrations

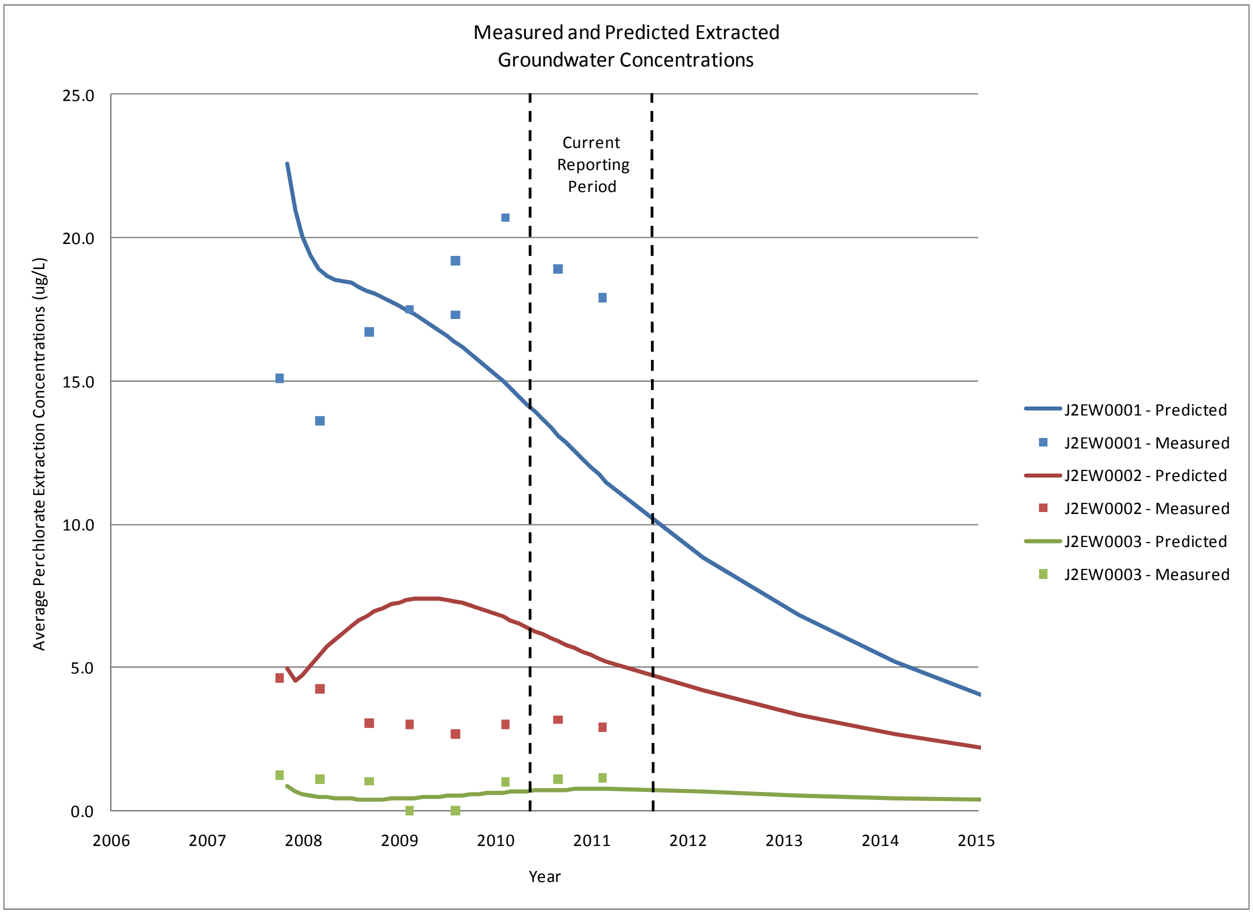
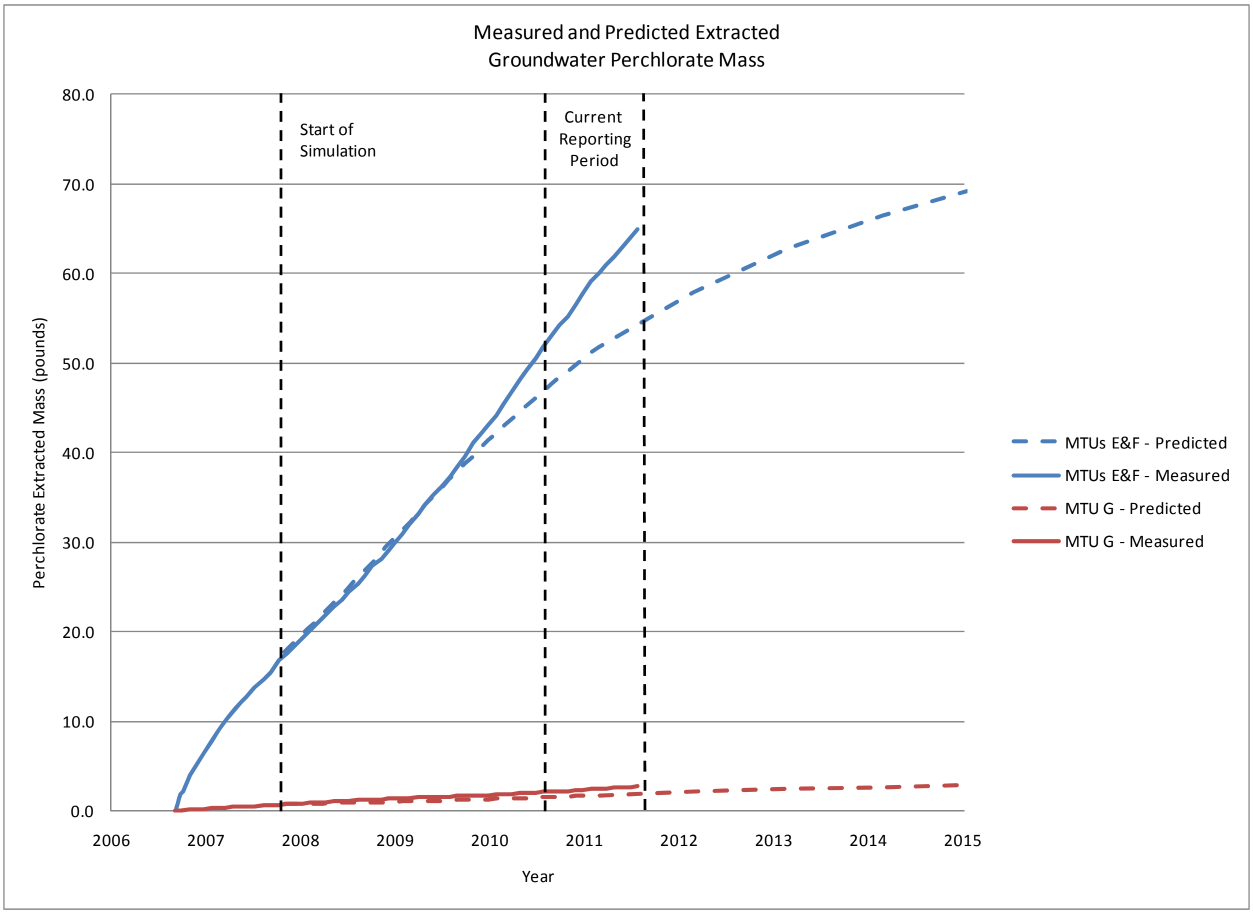
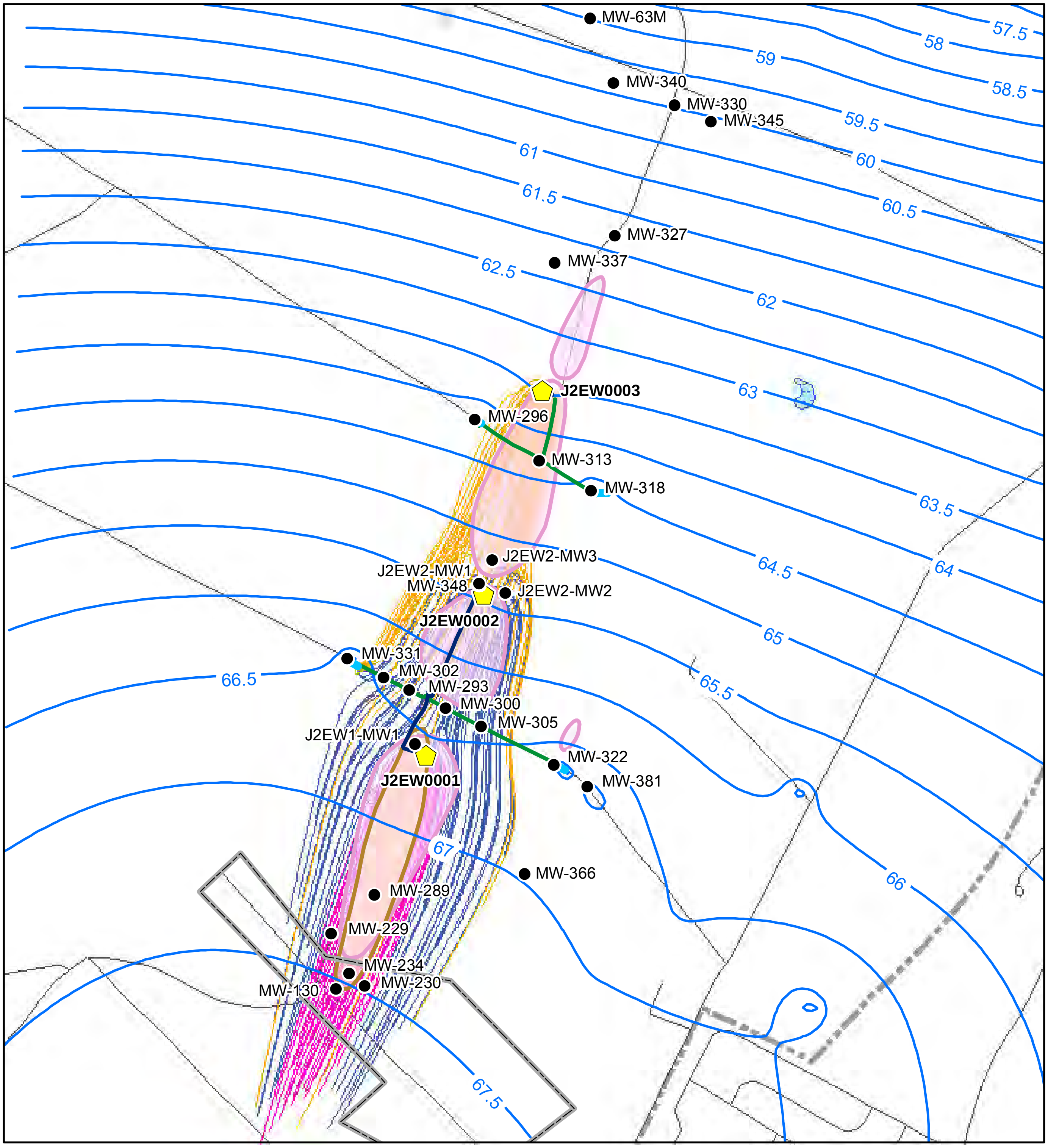


Figure 6-3
J-2 Range Northern ERT System Model Predicted and Observed Mass Removal





Legend

Extraction Well

Capture Zone Particle Tracks
J2EW0001
J2EW0002
J2EW0003
Infiltration Trench
Effluent Piping
Influent Piping
Perchlorate Plume Shown to 2 µg/L (Winter 2011)
RDX Plume Shown to 0.6 µg/L (Winter 2011)
MMR Boundary
66.5 Potentiometric Contours (Operational Conditions), 0.5 foot mean sea level intervals

Location Map

N

0 1,000 Feet

TITLE

Model-Predicted Capture Zone for J-2 Range Northern Groundwater

US Army Corps of Engineers New England District

Impact Area Groundwater Study Program

FIGURE 6-4

M:\MMR\2011\J-2North\AnnRpt\Figures\Fig6-7_111711.pdf
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November 17, 2011 DWN: MTW CHKD: KJH

TABLES

Table 1-1
J2 Range Northern Plume Groundwater Chemical Monitoring Network

Location	Northing (N83 UTM m)	Easting (N83 UTM m)	Surface Elevation (ft msl)	Screen Interval (ft msl)	Rationale for Location	Frequency (a)	Parameters (b)
J2EW0001	4,618,802	374,041	168.88	-10.12 to -65.12	Extraction well for J-2 Range North ETI System, used to help calculate and confirm mass removal by the system.	S	Explosives, Perchlorate
J2EW0002	4,619,259	374,205	171.58	-26.42 to -61.42	Extraction well for J-2 Range North ETI System, used to help calculate and confirm mass removal by the system.	S	Explosives, Perchlorate
J2EW0003	4,619,837	374,371	177.26	-24.74 to -54.74	Extraction well for J-2 Range North ETI System, used to help calculate and confirm mass removal by the system.	S	Perchlorate
J2EW1-MW1-A	4,618,833	374,010	173.43	32.61 to 22.61	Hydraulic well that can be used to monitor groundwater above the J 2 Range North plume.	B	Perchlorate
J2EW1-MW1-B	4,618,833	374,010	173.43	-32.39 to -42.39	Hydraulic well that can be used to monitor perchlorate and RDX contamination in the J-2 Range North plume.	A	Explosives, Perchlorate
J2EW1-MW1-C	4,618,833	374,010	173.43	-67.37 to -77.39	Hydraulic well that can be used to monitor groundwater under the J-2 Range North plume and help define the lower boundary of the perchlorate plume.	A	Explosives, Perchlorate
J2EW2-MW1-A	4,619,289	374,193	181.05	36.45 to 25.95	Piezometer placed for hydraulic monitoring that can be used to monitor groundwater above the J-2 Range North plume.	B	Perchlorate
J2EW2-MW2-A	4,619,261	374,267	181.10	36.65 to 26.65	Hydraulic well that can be used to monitor groundwater above the J 2 Range North plume.	B	Perchlorate
J2EW2-MW2-B	4,619,261	374,267	181.10	-28.69 to -38.69	Hydraulic well that can be used to monitor perchlorate and RDX contamination in the J-2 Range North plume.	A	Explosives, Perchlorate
J2EW2-MW2-C	4,619,261	374,267	181.10	-62.71 to -72.71	Hydraulic well that can be used to monitor groundwater under the J-2 Range North plume and help define the lower boundary of the perchlorate plume.	A	Explosives, Perchlorate
J2EW2-MW3-A	4,619,355	374,230	182.91	37.46 to 27.46	Hydraulic well that can be used to monitor groundwater above the J 2 Range North plume.	B	Perchlorate
J2EW2-MW3-B	4,619,355	374,230	182.91	-28.74 to -38.74	Hydraulic well that can be used to monitor perchlorate and RDX contamination in the J-2 Range North plume.	A	Explosives, Perchlorate
J2EW2-MW3-C	4,619,355	374,230	182.91	-63.09 to -73.09	Hydraulic well that can be used to monitor groundwater under the J-2 Range North plume and help define the lower boundary of the perchlorate plume.	A	Explosives, Perchlorate
J2EW3-MW2-A	4,619,930	374,450	187.53	36.37 to 26.37	Hydraulic well that can be used to monitor groundwater above the J 2 Range North plume.	B	Perchlorate
J2EW3-MW2-B	4,619,930	374,450	187.53	-28.63 to -38.63	Hydraulic well that can be used to monitor perchlorate and RDX contamination in the J-2 Range North plume.	S	Perchlorate
J2EW3-MW2-C	4,619,930	374,450	187.53	-63.60 to -73.60	Hydraulic well that can be used to monitor groundwater under the J-2 Range North plume and help define the lower boundary of the perchlorate plume.	A	Perchlorate
MW-130D	4,618,139	373,787	174.41	-145.59 to -155.59	Monitor groundwater beneath the source area and trailing edge of deep contamination.	B	Perchlorate
MW-130M1	4,618,139	373,787	174.41	14.41 to 4.41	Monitor groundwater beneath the source area.	A	Explosives, Perchlorate
MW-130S	4,618,139	373,786	174.41	71.41 to 61.41	Monitor groundwater contamination in proximity to the source area.	A	Explosives, Perchlorate
MW-229M1	4,618,295	373,772	178.24	-107.76 to -117.76	Monitor the groundwater under the western side of the J-2 Range North plume.	B	Perchlorate
MW-229M2	4,618,295	373,772	178.24	-27.76 to -37.76	Monitor perchlorate on the western side of the J-2 Range North plume.	B	Perchlorate
MW-229M3	4,618,295	373,772	178.24	37.24 to 27.24	Monitor perchlorate on the western side of the J-2 Range North plume.	A	Perchlorate
MW-229M4	4,618,295	373,772	178.24	61.24 to 51.24	Monitor perchlorate on the western side of the J-2 Range North plume.	B	Perchlorate
MW-230M1	4,618,147	373,868	172.13	42.13 to 32.13	Monitor the eastern side of the perchlorate plume.	A	Explosives, Perchlorate
MW-230M2	4,618,147	373,868	172.13	62.13 to 52.13	Monitor the eastern side of the perchlorate plume.	A	Explosives, Perchlorate
MW-234M1	4,618,183	373,823	173.91	43.91 to 33.91	Monitor the source area and trailing edge of the J-2 Range North plume.	A	Explosives, Perchlorate

Table 1-1
J2 Range Northern Plume Groundwater Chemical Monitoring Network

Location	Northing (N83 UTM m)	Easting (N83 UTM m)	Surface Elevation (ft msl)	Screen Interval (ft msl)	Rationale for Location	Frequency (a)	Parameters (b)
MW-234M2	4,618,183	373,823	173.91	63.91 to 53.91	Monitor the source area and trailing edge of the J-2 Range North plume.	A	Explosives, Perchlorate
MW-289M1	4,618,406	373,895	169.18	-135.44 to -145.44	Monitor contaminants in the low conductivity deposits below the J-2 Range North plume.	A	Explosives, Perchlorate
MW-289M2	4,618,406	373,895	169.18	7.16 to -2.84	Monitor the core of the J-2 Range North plume.	A	Explosives, Perchlorate
MW-289S	4,618,406	373,895	169.18	64.54 to 54.49	Monitor shallow, and possibly detached RDX groundwater contamination downgradient of the source area.	B	Explosives, Perchlorate
MW-293M1	4,618,986	373,994	173.80	-122.46 to -132.47	Monitor contaminants in the low conductivity deposits below the J-2 Range North plume.	A	Perchlorate
MW-293M2	4,618,987	373,994	173.80	-22.62 to -32.62	Monitor contaminants in the core of the J-2 Range North plume.	A	Explosives, Perchlorate
MW-293S	4,618,987	373,994	173.80	63.7 to 53.68	Monitor shallow, and possibly detached perchlorate groundwater contamination over the core of the J-2 Range North plume.	B	Perchlorate
MW-296M1	4,619,754	374,181	186.29	-68.79 to -78.79	Monitor western boundary of the J-2 Range North plume.	A	Perchlorate
MW-296M2	4,619,754	374,181	186.29	-28.69 to -38.69	Monitor western boundary of the J-2 Range North plume.	A	Perchlorate
MW-300M1	4,618,935	374,097	171.38	-121.65 to -131.64	Monitor groundwater below core of J-2 Range North plume.	B	Perchlorate
MW-300M2	4,618,935	374,097	171.38	-25.85 to -35.85	Monitor core of J-2 Range North plume.	A	Explosives, Perchlorate
MW-300M3	4,618,935	374,097	171.38	36.07 to 26.07	Monitor groundwater above core of J-2 Range North plume.	B	Perchlorate
MW-302M1	4,619,022	373,921	177.05	-122.59 to -132.69	Monitor groundwater below core of J-2 Range North plume.	B	Perchlorate
MW-302M2	4,619,022	373,921	177.05	-17.3 to -27.38	Monitor western side of the J-2 Range North plume.	A	Explosives, Perchlorate
MW-305M1	4,618,883	374,198	177.60	-25.22 to -35.22	Monitor perchlorate contamination at the core of the J-2 Range North plume.	A	Explosives, Perchlorate
MW-313M1	4,619,637	374,363	186.42	-69 to -79	Monitor groundwater below core of J-2 Range North plume for well performance.	S	Perchlorate
MW-313M2	4,619,637	374,363	186.42	-29.04 to -39.07	Monitor perchlorate contamination at the core of the J-2 Range North plume for well performance.	S	Perchlorate
MW-313M3	4,619,637	374,363	186.42	-8.65 to -19.15	Monitor groundwater above core of J-2 Range North plume for well performance.	S	Perchlorate
MW-318M1	4,619,552	374,510	185.99	-119.8 to -129.82	Monitor groundwater on eastern boundary of J-2 Range North plume.	A	Perchlorate
MW-318M2	4,619,552	374,510	185.99	-19.81 to -29.83	Monitor groundwater on eastern boundary of J-2 Range North plume.	A	Perchlorate
MW-322M1	4,618,775	374,404	182.46	-63.31 to -73.31	Monitor eastern side of J-2 Range North plume.	A, S	Explosives, Perchlorate
MW-327M1	4,620,275	374,578	174.97	-121.09 to -131.07	Monitor groundwater downgradient of the leading edge of the J-2 Range North plume.	A	Perchlorate
MW-327M2	4,620,275	374,578	174.97	-90.04 to -100.04	Monitor groundwater downgradient of the leading edge of the J-2 Range North plume.	A	Perchlorate
MW-327M3	4,620,275	374,578	174.97	-45.19 to -55.18	Monitor groundwater near the leading edge of the J-2 Range North plume.	S	Perchlorate
MW-330M2	4,620,646	374,746	187.73	-50.28 to -60.31	Monitor groundwater downgradient of the leading edge of the J-2 Range North plume.	A	Perchlorate
MW-331M1	4,619,075	373,818	180.22	-54.78 to -64.78	Monitor groundwater at the western boundary of the J-2 Range North plume.	A	Perchlorate
MW-331M2	4,619,075	373,818	180.22	-14.78 to -24.78	Monitor groundwater at the western boundary of the J-2 Range North plume.	A	Perchlorate
MW-337M1	4,620,199	374,408	189.34	-54.37 to -64.37	Monitor groundwater near the leading edge of the J-2 Range North plume.	S	Perchlorate
MW-340M1	4,620,709	374,574	198.65	-57.2 to -67.2	Monitor groundwater downgradient of the leading edge of the J-2 Range North plume.	A	Perchlorate
MW-340M2	4,620,709	374,574	198.65	-17.18 to -26.43	Monitor groundwater downgradient of the leading edge of the J-2 Range North plume.	A	Perchlorate
MW-345M2	4,620,599	374,851	185.85	-50.77 to -60.77	Monitor groundwater downgradient of the leading edge of the J-2 Range North plume.	A	Perchlorate

Table 1-1
J2 Range Northern Plume Groundwater Chemical Monitoring Network

Location	Northing (N83 UTM m)	Easting (N83 UTM m)	Surface Elevation (ft msl)	Screen Interval (ft msl)	Rationale for Location	Frequency (a)	Parameters (b)
MW-348M1	4,619,286	374,192	180.61	-107.85 to -117.85	Monitor groundwater below core of J-2 Range North plume.	NA	NA
MW-348M2	4,619,286	374,192	180.61	-25.93 to -35.93	Monitor groundwater in the core of the J-2 Range North plume.	A	Perchlorate
MW-366M1	4,618,465	374,321	153.13	-61.87 to -71.87	Monitor groundwater on eastern boundary of J-2 Range North plume.	NA	NA
MW-366M2	4,618,465	374,321	153.13	-21.87 to -31.87	Monitor groundwater on eastern boundary of J-2 Range North plume.	NA	NA
MW-366M3	4,618,465	374,321	153.13	8.13 to -1.87	Monitor groundwater on eastern boundary of J-2 Range North plume.	NA	NA
MW-381M1	4,618,711	374,499	182.00	-50.94 to -60.94	Monitor groundwater in deep portion of eastern boundary of the J-2 Range North plume.	NA	NA
MW-381M2	4,618,711	374,499	182.00	-14.39 to -24.39	Monitor groundwater on eastern boundary of J-2 Range North plume.	NA	NA
MW-63M1	4,620,893	374,507	215.50	-28.5 to -38.5	Monitor groundwater downgradient of the leading edge of the J-2 Range North plume.	A	Perchlorate
MW-63M2	4,620,892	374,507	215.50	1.5 to -8.5	Monitor groundwater downgradient of the leading edge of the J-2 Range North plume.	A	Perchlorate

Notes:
Shading indicates a deviation.

ft = feet
msl = mean sea level
N83UTM m = North American Datum 83 Universal Transverse Mercator (meters)
RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine

(a)
A = annually
B = biennial
S = semiannually

(b)
Explosives = EPA Method SW846/8330
Perchlorate = EPA Method E314.0

Table 2-1
Plant Maintenance, Availability, and Downtime Summary

Month	Plant	Availability / Up-Time *		Maintenance/Downtime for Period		
		Period	Start-up to Date	Pump Hours**	Event	Date/Action
August 2010	Wood Rd. MTUs E&F	98.8%	97.2%	11.17 8.00	1. System shutdown due to power supply interruption. 2. System shutdown due to power supply interruption.	1. System down at 0811 h on 11 August and restarted 1931 h on 11 August. 2. Power off at 0335 17 August and restarted 0735 h.
	Jefferson Rd. MTU G	100.0%	98.2%	0.00	No Downtime	No Downtime
September 2010	Wood Rd. MTUs E&F	96.9%	97.2%	44.63	Turned off system in preparation of approaching Hurricane Earl.	The system was shutdown at 1231 h on 3 September and restarted at 0953 h on 4 September.
	Jefferson Rd. MTU G	97.1%	98.2%	20.72 0.50	1. System shut down for LTM sampling event. 2. Turned off system in preparation of approaching Hurricane Earl.	1. The system was shutdown at 1047 h on 3 September and restarted at 0730 h on 4 September. 2. Shut down at 1140 h on 8 September and restarted at 1210 h on 8 September.
October 2010	Wood Rd. MTUs E&F	88.6%	97.1%	30.17 47.78 14.50 16.40 49.55	1. Well EW-001 shut down for well maintenance. 2. Well EW-002 shut down for well maintenance. 3. Well EW-002 power supply interruption. 4. Well EW-002 power supply interruption. 5. Well EW-002 turned off to protect and fix pump motor.	1. Well EW-001 down at 0850 h on 19 October and restarted 1500 h on 20 October. 2. EW-002 also down at 0850 h on 19 October and restarted 0837 h on 21 October. EW-001 pump was running alone for ~17 hours feeding the Wood Rd system. 3. EW-002 down at 1821 h on 22 October and restarted 0852 h on 22 October. EW-001 pump ran during this time feeding the Wood Rd system. 4. EW-002 down at 1827 h on 22 October and restarted 1051 h on 23 October. EW-001 pump ran during this time feeding the Wood Rd system. 5. EW-002 pump turned off at 1230 h on 23 October and restarted 1403 h on 25 October. EW-001 pump ran during this time feeding the Wood Rd system.
	Jefferson Rd. MTU G	96.8%	98.2%	22.33	System shutdown for EW-003 pump maintenance.	The system was shutdown at 1340 h on 19 October and restarted at 1200 h on 20 October.
November 2010	Wood Rd. MTUs E&F	99.4%	97.1%	8.93	System shutdown due to power supply interruption.	System down at 0438 h on 17 November and restarted 0906 h.
	Jefferson Rd. MTU G	100.0%	98.2%	0.00	No Downtime	No Downtime

Table 2-1
Plant Maintenance, Availability, and Downtime Summary

Month	Plant	Availability / Up-Time *		Maintenance/Downtime for Period		
		Period	Start-up to Date	Pump Hours**	Event	Date/Action
December 2010	Wood Rd. MTUs E&F	98.9%	97.1%	15.70	System shutdown due to storm related power supply interruption.	System down at 0109 h on 20 December and restarted at 0900 h.
	Jefferson Rd. MTU G	96.6%	98.2%	7.57 17.12	1. System shut down due to storm related power supply interruptions. 2. System shut down due to power surge.	1. The system was shutdown at 0210 h on 21 December and restarted at 0944 h. 2. Shut down at 1613 h on 26 December and restarted at 0920 h on 27 December.
January 2011	Wood Rd. MTUs E&F	99.4%	97.2%	2.50 2.10 4.72	1. System shut down due to power supply interruption. 2. Well EW-002 shut down due to sump alarm. 3. Well EW-002 power supply interruption.	1. System down at 1259 h on 06 January and restarted 1414 h. 2. Well EW-002 down at 1304 h on 10 January and restarted 1510 h on 10 January. EW-001 pump ran during this time. 3. Well EW-002 down at 0440 h on 11 January and restarted 0923 h on 11 January. EW-001 pump ran during this time.
	Jefferson Rd. MTU G	99.9%	98.2%	0.93	System shut down due power surge.	The system was shutdown at 1259 h on 06 January and restarted at 1355 h.
February 2011	Wood Rd. MTUs E&F	98.2%	97.2%	19.80 2.25 2.57	1. System shut down due to power supply interruption. 2. Well EW-002 shut down due to groundwater pump fault. 3. Well EW-002 down due to storm related power supply interruption.	1. System down at 2346 h on 05 February and restarted 0940 h on 06 February. 2. Well EW-002 down at 0837 h on 07 February and restarted 1052 h. EW-001 pump ran during this time. 3. Well EW-002 down at 1102 h on 19 February and restarted 1336 h. EW-001 pump ran during this time.
	Jefferson Rd. MTU G	98.5%	98.2%	9.90	System shut down due to power supply interruption.	The system was shutdown at 2346 h on 05 February and restarted at 0940 h on 06 February.
March 2011	Wood Rd. MTUs E&F	81.7%	96.9%	263.50	Well EW-002 shut down due to faulty pump and faulty VFD. Both replaced.	EW-002 down at 1200 h on 18 March. Pump & VFD replaced. EW-002 restarted 1130 h on 29 March. EW-001 pump ran during this time.
	Jefferson Rd. MTU G	99.5%	98.3%	3.37	System shut down due to power supply interruption.	The system was shutdown at 0910 h on 17 March and restarted at 1232 h.

Table 2-1
Plant Maintenance, Availability, and Downtime Summary

Month	Plant	Availability / Up-Time *		Maintenance/Downtime for Period		
		Period	Start-up to Date	Pump Hours**	Event	Date/Action
April 2011	Wood Rd. MTUs E&F	92.4%	96.8%	8.08 7.85 92.30 0.73	1. Well EW-001 shut down due to faulty internet cable. 2. Well EW-002 down due to power supply interruption. 3. System down for media (IX and GAC) exchange. 4. Well EW-001 down due to power supply interruption.	1. Well EW-001 down at 0415 h on 01 April and restarted 1220 h. 2. Well EW-002 down at 0423 h on 01 April and restarted 1215 h. 3. System down at 1509 h on 04 April and restarted 1318 h on 06 April. 4. Well EW-001 down at 0911 hon 18 April and restarted at 0955. Well EW-002 up during this time.
	Jefferson Rd. MTU G	100.0%	98.3%	0.00	No Downtime	No Downtime
May 2011	Wood Rd. MTUs E&F	100.0%	96.9%	0.00	No Downtime	No Downtime
	Jefferson Rd. MTU G	100.0%	98.3%	0.00	No Downtime	No Downtime
June 2011	Wood Rd. MTUs E&F	99.8%	97.0%	0.33 0.47 1.77	1. Well EW-002 down due to power supply interruption. Well EW-001 up. 2. Well EW-002 shut down due to pressure alarm. Well EW-001 up. 3. Well EW-002 down due to power supply interruption.	1. Well EW-002 down at 0937 h on 15 June and restarted 0957 h. 2. Well EW-002 down at 0900 h on 20 June and restarted 0928 h. EW-001 pump ran during this time. 3. Well EW-002 down at 0902 h on 21 June and restarted 1048 h. EW-001 pump ran during this time.
	Jefferson Rd. MTU G	100.0%	98.4%	0.00	No Downtime	No Downtime

Table 2-1
Plant Maintenance, Availability, and Downtime Summary

Month	Plant	Availability / Up-Time *		Maintenance/Downtime for Period		
		Period	Start-up to Date	Pump Hours**	Event	Date/Action
July 2011	Wood Rd. MTUs E&F	98.0%	97.0%	10.27 11.92 0.83 0.92 3.33	1. Well EW-002 shut down for pump maintenance. 2. Well EW-002 shut down for pump maintenance. 3. Well EW-001 down due to storm related power supply interruption. 4. Well EW-002 power down due to storm related supply interruption. 5. Well EW-002 down due to pump fault.	1. Well EW-002 down at 0941 h on 02 July and restarted 1957 h. EW-001 pump was running during that time. 2. Well EW-002 down at 2100 h on 4 July and restarted 0855 h on 5 July. EW-001 pump was running. 3. Well EW-001 down at 1729 h on 18 July and restarted 1819 h. 4. Well EW-002 down at 1727 h on 18 July and restarted 1822 h on 18 July.. 5. Well EW-002 pump turned off at 0902 h on 23 July and restarted 1222 h. EW-001 pump ran during this time.
	Jefferson Rd. MTU G	99.9%	98.4%	0.65	System shut down due to storm related high level switch.	The system was shutdown at 1725 h on 18 July and restarted at 1804 h.
		Cumulative % Available		Pump Hours Down		
		Reporting Period	Since Startup			
Through 31 July 2011 Wood Road MTUs E&F		97.58%	98.86%	400.43	Downtime During Reporting Period: Planned Shutdowns	
				282.63	Downtime During Reporting Period: Unplanned Shutdowns	
				683.1	Total Downtime Hours During Reporting Period	
				2595.64	Total Downtime hours since Startup	
Through 31 July 2011 Jefferson Road MTU G		99.05%	98.4%	46.9	Downtime During Reporting Period: Planned Shutdowns	
				36.17	Downtime During Reporting Period: Unplanned Shutdowns	
				83.08	Total Downtime Hours During Reporting Period	
				696.77	Total Downtime hours since Startup	

Notes:
*The Wood Road treatment system is fed by two extraction wells. Sometimes, only a single well and the other pump continues pumping from the other well. Thus, up-time (and downtime) for this system is characterized by pump hours. There were 2 x 8736 possible pump hours during this reporting period.

** If both pumps were off for one hour, then downtime = 2 "pump hours". Unless otherwise noted, hours entered under pump hours is for both pumps.

Table 3-1
J-2 Northern Modular Treatment Units E and F
Analytical Results

Date	Time	Location Identifier	Sample Port	Laboratory Analyses			Field Parameters					
				Explosives		Perchlorate (µg/L)	Temp (°C)	SpC (µS/cm)	DO (mg/L)	pH	ORP (mV)	Turbidity (ntu)
				RDX (µg/L)	HMX (µg/L)							
8/11/2010	11:30	J2N-INF-E	J2N-INF-E-47A	ND	ND	12.7	11.14	31	11.61	6.92	159.9	0.00
8/11/2010	11:35	J2N-MID-1E	J2N-MID-1E-47A	NS	NS	ND	10.64	27	11.59	6.8	162.7	0.00
8/11/2010	11:40	J2N-MID-2E	J2N-MID-2E-47A	ND	ND	NS	10.78	37	11.75	6.64	167.7	0.00
8/11/2010	11:45	J2N-EFF-E	J2N-EFF-E-47A	C	C	C	10.96	37	11.28	6.59	169.4	0.00
8/11/2010	11:50	J2N-MID-1F	J2N-MID-1F-47A	NS	NS	ND	11.08	37	11.03	6.58	169.7	0.00
8/11/2010	11:55	J2N-MID-2F	J2N-MID-2F-47A	ND	ND	0.06	10.64	37	11.46	6.54	175.8	0.00
8/11/2010	12:00	J2N-EFF-F	J2N-EFF-F-47A	C	C	C	10.66	37	12.14	6.5	181.4	0.00
	C	J2N-EFF-EF	J2N-EFF-47A	ND	ND	ND						
9/7/2010	10:45	J2N-INF-E	J2N-INF-E-48A	0.305	ND	14.1	11.14	44	11.61	6.92	136.9	0.00
9/7/2010	10:50	J2N-MID-1E	J2N-MID-1E-48A	NS	NS	ND	10.81	38	11.6	6.8	141.1	0.00
9/7/2010	10:55	J2N-MID-2E	J2N-MID-2E-48A	ND	ND	NS	10.94	44	11.42	6.64	147.4	0.00
9/7/2010	11:00	J2N-EFF-E	J2N-EFF-E-48A	C	C	C	10.89	40	11.33	6.59	148.3	0.00
9/7/2010	11:05	J2N-MID-1F	J2N-MID-1F-48A	NS	NS	ND	10.86	38	11.66	6.58	152.6	0.00
9/7/2010	11:10	J2N-MID-2F	J2N-MID-2F-48A	ND	ND	ND	10.77	21	11.49	6.54	159.3	0.00
9/7/2010	11:15	J2N-EFF-F	J2N-EFF-F-48A	C	C	C	10.91	28	11.48	6.5	158	0.00
	C	J2N-EFF-EF	J2N-EFF-48A	ND	ND	ND						
10/5/2010	12:15	J2N-INF-E	J2N-INF-E-49A	ND	ND	13.9	10.48	44	11.39	6.42	132.6	0.00
10/5/2010	12:20	J2N-MID-1E	J2N-MID-1E-49A	NS	NS	ND	10.25	42	11.48	6.36	135.7	0.00
10/5/2010	12:25	J2N-MID-2E	J2N-MID-2E-49A	ND	ND	NS	10.30	34	11.43	6.22	141.2	0.00
10/5/2010	12:30	J2N-EFF-E	J2N-EFF-E-49A	C	C	C	10.32	35	11.27	6.17	145.8	0.00
10/5/2010	12:30	J2N-MID-1F	J2N-MID-1F-49A	NS	NS	ND	10.36	31	11.99	6.2	155.5	0.00
10/5/2010	12:35	J2N-MID-2F	J2N-MID-2F-49A	ND	ND	ND	10.24	27	11.47	6.2	156.5	0.00
10/5/2010	12:40	J2N-EFF-F	J2N-EFF-F-49A	C	C	C	10.29	30	11.42	6.12	161.8	0.00
	C	J2N-EFF-EF	J2N-EFF-49A	ND	ND	ND						
11/8/2010	10:35	J2N-INF-E	J2N-INF-E-50A	ND	ND	13.8	9.65	47	12.69	6.52	148.6	0.00
11/8/2010	10:40	J2N-MID-1E	J2N-MID-1E-50A	NS	NS	ND	9.76	48	11.53	6.39	155.6	0.00
11/8/2010	10:45	J2N-MID-2E	J2N-MID-2E-50A	ND	ND	NS	9.73	43	11.52	6.37	155.2	0.00
11/8/2010	10:50	J2N-EFF-E	J2N-EFF-E-50A	C	C	C	9.70	47	11.44	6.36	156.8	0.00
11/8/2010	10:55	J2N-MID-1F	J2N-MID-1F-50A	NS	NS	ND	9.52	46	11.73	6.38	160.3	0.00
11/8/2010	11:00	J2N-MID-2F	J2N-MID-2F-50A	ND	ND	ND	9.76	49	11.55	6.3	163	0.00
11/8/2010	11:05	J2N-EFF-F	J2N-EFF-F-50A	C	C	C	9.83	49	11.53	6.28	166.7	0.00
	C	J2N-EFF-EF	J2N-EFF-50A	ND	ND	ND						
12/6/2010	11:25	J2N-INF-E	J2N-INF-E-51A	ND	ND	14.7	9.40	47	11.63	6.57	152.7	0.00
12/6/2010	11:30	J2N-MID-1E	J2N-MID-1E-51A	NS	NS	ND	9.59	49	11.62	6.5	154.2	0.00
12/6/2010	11:35	J2N-MID-2E	J2N-MID-2E-51A	ND	ND	NS	9.58	49	11.65	6.42	155.9	0.00
12/6/2010	11:40	J2N-EFF-E	J2N-EFF-E-51A	C	C	C	9.52	50	11.52	6.4	158.3	0.00
12/6/2010	11:45	J2N-MID-1F	J2N-MID-1F-51A	NS	NS	ND	9.27	48	12.02	6.47	177.2	0.00
12/6/2010	11:50	J2N-MID-2F	J2N-MID-2F-51A	ND	ND	ND	9.55	48	11.82	6.41	176.2	0.00
12/6/2010	11:55	J2N-EFF-F	J2N-EFF-F-51A	C	C	C	9.56	48	11.68	6.36	178	0.00
	C	J2N-EFF-EF	J2N-EFF-51A	ND	ND	ND						
1/10/2011	11:00	J2N-INF-E	J2N-INF-E-52A	0.252	ND	13.4	9.08	49	11.59	6.34	180.7	0.00
1/10/2011	11:05	J2N-MID-1E	J2N-MID-1E-52A	NS	NS	ND	9.35	51	11.55	6.32	183.9	0.00
1/10/2011	11:10	J2N-MID-2E	J2N-MID-2E-52A	ND	ND	NS	9.47	51	11.54	6.27	188.2	0.00
1/10/2011	11:15	J2N-EFF-E	J2N-EFF-E-52A	C	C	C	9.38	50	11.37	6.23	187	0.00
1/10/2011	11:20	J2N-MID-1F	J2N-MID-1F-52A	NS	NS	ND	9.35	50	11.66	6.26	214.2	0.00
1/10/2011	11:25	J2N-MID-2F	J2N-MID-2F-52A	ND	ND	ND	9.6	49	11.53	6.21	208.4	0.00
1/10/2011	11:30	J2N-EFF-F	J2N-EFF-F-52A	C	C	C	9.55	49	11.44	6.16	213.2	0.00
	C	J2N-EFF-EF	J2N-EFF-52A	ND	ND	ND						
2/8/2011	10:30	J2N-INF-E	J2N-INF-E-53A	ND	ND	12.4	9.29	47	11.91	6.88	185.7	0.00
2/8/2011	10:35	J2N-MID-1E	J2N-MID-1E-53A	NS	NS	ND	9.48	48	11.97	6.79	186.4	0.00
2/8/2011	10:40	J2N-MID-2E	J2N-MID-2E-53A	ND	ND	NS	9.53	48	11.91	6.7	189	0.00
2/8/2011	10:45	J2N-EFF-E	J2N-EFF-E-53A	C	C	C	9.51	50	11.75	6.66	191.6	0.00
2/8/2011	10:50	J2N-MID-1F	J2N-MID-1F-53A	NS	NS	ND	9.52	49	11.84	6.6	191.2	0.00
2/8/2011	10:55	J2N-MID-2F	J2N-MID-2F-53A	ND	ND	ND	9.62	49	11.82	6.58	191.2	0.00
2/8/2011	11:00	J2N-EFF-F	J2N-EFF-F-53A	C	C	C	9.63	47	11.73	6.58	189.6	0.00
	C	J2N-EFF-EF	J2N-EFF-53A	ND	ND	ND						

Table 3-1
J-2 Northern Modular Treatment Units E and F
Analytical Results

Date	Time	Location Identifier	Sample Port	Laboratory Analyses			Field Parameters					
				Explosives		Perchlorate (µg/L)	Temp (°C)	SpC (µS/cm)	DO (mg/L)	pH	ORP (mV)	Turbidity (ntu)
				RDX (µg/L)	HMX (µg/L)							
3/7/2011	10:40	J2N-INF-E	J2N-INF-E-54A	0.295	ND	11.3	9.61	49	11.44	6.72	170.7	0.00
3/7/2011	10:45	J2N-MID-1E	J2N-MID-1E-54A	NS	NS	ND	9.62	49	11.6	6.61	174.3	0.00
3/7/2011	10:50	J2N-MID-2E	J2N-MID-2E-54A	**0.262**	ND	NS	9.62	49	11.58	6.49	178.7	0.00
3/7/2011	10:55	J2N-EFF-E	J2N-EFF-E-54A	C	C	C	9.62	50	11.41	6.44	179.9	0.00
3/7/2011	11:00	J2N-MID-1F	J2N-MID-1F-54A	NS	NS	ND	9.69	48	11.59	6.44	185.4	0.00
3/7/2011	11:05	J2N-MID-2F	J2N-MID-2F-54A	ND	ND	ND	9.7	49	11.57	6.34	189.6	0.00
3/7/2011	11:10	J2N-EFF-F	J2N-EFF-F-54A	C	C	C	9.72	50	11.48	6.27	193.6	0.00
	C	J2N-EFF-EF	J2N-EFF-54A	ND	ND	ND						
4/11/2011	11:05	J2N-INF-E	J2N-INF-E-55A	ND	ND	11.8	9.87	58	11.49	6.38	204.9	0.00
4/11/2011	11:10	J2N-MID-1E	J2N-MID-1E-55A	NS	NS	ND	9.82	58	11.51	6.44	206.2	0.00
4/11/2011	11:15	J2N-MID-2E	J2N-MID-2E-55A	ND	ND	NS	9.82	58	11.44	6.41	209.1	0.00
4/11/2011	11:20	J2N-EFF-E	J2N-EFF-E-55A	C	C	C	9.80	57	11.37	6.47	208.8	0.00
4/11/2011	11:25	J2N-MID-1F	J2N-MID-1F-55A	NS	NS	ND	9.86	57	11.67	6.42	217.8	0.00
4/11/2011	11:30	J2N-MID-2F	J2N-MID-2F-55A	ND	ND	ND	9.87	57	11.49	6.32	219.7	0.00
4/11/2011	11:35	J2N-EFF-F	J2N-EFF-F-55A	C	C	C	9.88	57	11.52	6.31	220.7	0.00
	C	J2N-EFF-EF	J2N-EFF-55A	ND	ND	ND						
5/9/2011	10:45	J2N-INF-E	J2N-INF-E-56A	ND	ND	11.1	10.39	60	10.87	6.53	219.7	0.00
5/9/2011	10:50	J2N-MID-1E	J2N-MID-1E-56A	NS	NS	ND	9.98	59	10.94	6.5	232.2	0.00
5/9/2011	10:55	J2N-MID-2E	J2N-MID-2E-56A	ND	ND	NS	10.02	59	10.8	6.35	243.1	0.00
5/9/2011	11:00	J2N-EFF-E	J2N-EFF-E-56A	C	C	C	10.13	59	12.16	6.55	219.9	0.00
5/9/2011	11:05	J2N-MID-1F	J2N-MID-1F-56A	NS	NS	ND	10.38	58	11.67	6.37	232.4	0.00
5/9/2011	11:10	J2N-MID-2F	J2N-MID-2F-56A	ND	ND	ND	10.13	58	11.49	6.35	237.9	0.00
5/9/2011	11:15	J2N-EFF-F	J2N-EFF-F-56A	C	C	C	10.15	58	11.52	6.34	239.3	0.00
	C	J2N-EFF-EF	J2N-EFF-56A	ND	ND	ND						
6/6/2011	10:45	J2N-INF-E	J2N-INF-E-57A	ND	ND	11.7	10.81	59	10.91	6.51	182.6	0.00
6/6/2011	10:50	J2N-MID-1E	J2N-MID-1E-57A	NS	NS	ND	10.39	59	11.21	6.5	185.8	0.00
6/6/2011	10:55	J2N-MID-2E	J2N-MID-2E-57A	ND	ND	NS	10.64	59	10.61	6.4	190.1	0.00
6/6/2011	11:00	J2N-EFF-E	J2N-EFF-E-57A	C	C	C	10.65	61	10.94	6.46	187.5	0.00
6/6/2011	11:05	J2N-MID-1F	J2N-MID-1F-57A	NS	NS	ND	10.58	59	11.2	6.51	184.4	0.00
6/6/2011	11:10	J2N-MID-2F	J2N-MID-2F-57A	ND	ND	ND	10.41	58	11.18	6.38	187.5	0.00
6/6/2011	11:15	J2N-EFF-F	J2N-EFF-F-57A	C	C	C	10.57	58	10.97	6.4	192.7	0.00
	C	J2N-EFF-EF	J2N-EFF-57A	ND	ND	ND						
7/11/2011	11:45	J2N-INF-E	J2N-INF-E-58A	ND	ND	10.8	10.94	60	10.93	6.54	137.7	0.00
7/11/2011	11:50	J2N-MID-1E	J2N-MID-1E-58A	NS	NS	ND	10.40	59	10.93	6.54	140.6	0.00
7/11/2011	11:55	J2N-MID-2E	J2N-MID-2E-58A	ND	ND	NS	10.42	59	10.88	6.48	145.1	0.00
7/11/2011	12:00	J2N-EFF-E	J2N-EFF-E-58A	C	C	C	10.45	59	10.75	6.51	146.5	0.00
7/11/2011	12:05	J2N-MID-1F	J2N-MID-1F-58A	NS	NS	ND	10.99	59	11.66	6.59	165.1	0.00
7/11/2011	12:10	J2N-MID-2F	J2N-MID-2F-58A	ND	ND	ND	10.55	59	10.93	6.51	165.7	0.00
7/11/2011	12:15	J2N-EFF-F	J2N-EFF-F-58A	C	C	C	10.61	58	10.86	6.43	168.4	0.00
	C	J2N-EFF-EF	J2N-EFF-58A	ND	ND	ND						

Legend:

RDX = Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	NA = not available	Temp = temperature	°C = degrees Celsius
HMX = Octahydro-1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine	NS = not sampled	SpC = specific conductivity	µS/cm = microsiemens per centimeter
µg/L = micrograms per liter (parts per billion)	**Breakthrough Detected**	DO = dissolved oxygen	mg/L = milligrams per liter (parts per million)
ND = 0.25 µg/L for RDX and HMX; 0.35 ug/L for Perchlorate	C=Composited Samples	ORP = oxidation reduction potentia	mV = millivolts
		Turb = turbidity	ntu = nephelometric turbidity units

Where duplicate sample results were available, the result presented is the average of the two samples.

Table 3-2
J-2 Northern Modular Treatment Unit G
Analytical Results

Date	Time	Location Identifier	Sample Port	Laboratory Analyses			Field Parameters					
				Explosives		Perchlorate	Temp (°C)	SpC (µS/cm)	DO (mg/L)	pH	ORP (mV)	Turb. (ntu)
				RDX (µg/L)	HMX (µg/L)							
8/10/2010	11:00	J2N-INF-G	J2N-INF-G-47A	ND	ND	0.996	10.99	39	11.77	6.92	155.1	0.00
8/10/2010	11:05	J2N-MID-1G	J2N-MID-1G-47A	NS	NS	ND	10.26	20	12.06	6.91	150.8	0.00
8/10/2010	11:10	J2N-MID-2G	J2N-MID-2G-47A	ND	ND	NS	10.35	34	11.72	6.84	150.2	0.00
8/10/2010	11:15	J2N-EFF-G	J2N-EFF-G-47A	ND	ND	ND	10.41	32	11.62	6.72	154.9	0.00
9/7/2010	9:55	J2N-INF-G	J2N-INF-G-48A	ND	ND	1.05	10.58	35	11.21	6.92	100.7	0.00
9/7/2010	10:00	J2N-MID-1G	J2N-MID-1G-48A	NS	NS	ND	10.15	38	11.47	6.85	125.1	0.00
9/7/2010	10:05	J2N-MID-2G	J2N-MID-2G-48A	ND	ND	NS	10.30	44	11.22	6.73	127	0.00
9/7/2010	10:10	J2N-EFF-G	J2N-EFF-G-48A	ND	ND	ND	10.36	48	11.12	6.57	130.7	0.00
10/5/2010	11:40	J2N-INF-G	J2N-INF-G-49A	ND	ND	1.12	10.45	59	11.29	7.12	96.6	0.00
10/5/2010	11:45	J2N-MID-1G	J2N-MID-1G-49A	NS	NS	ND	10.10	51	11.48	6.93	99.7	0.00
10/5/2010	11:50	J2N-MID-2G	J2N-MID-2G-49A	ND	ND	NS	10.19	50	11.23	6.67	108.7	0.00
10/5/2010	11:55	J2N-EFF-G	J2N-EFF-G-49A	ND	ND	ND	10.15	49	11.17	6.6	112.3	0.00
11/8/2010	10:05	J2N-INF-G	J2N-INF-G-50A	ND	ND	1.17	9.85	57	11.42	7.17	129.1	0.00
11/8/2010	10:10	J2N-MID-1G	J2N-MID-1G-50A	NS	NS	ND	9.74	47	11.38	6.75	128.9	0.00
11/8/2010	10:15	J2N-MID-2G	J2N-MID-2G-50A	ND	ND	NS	9.67	49	11.37	6.61	130.9	0.00
11/8/2010	10:20	J2N-EFF-G	J2N-EFF-G-50A	ND	ND	ND	9.68	49	11.25	6.54	132.1	0.00
12/6/2010	10:50	J2N-INF-G	J2N-INF-G-51A	ND	ND	1.2	9.64	47	11.52	6.84	138.5	0.00
12/6/2010	10:55	J2N-MID-1G	J2N-MID-1G-51A	NS	NS	ND	9.69	46	11.6	6.68	142.9	0.00
12/6/2010	11:00	J2N-MID-2G	J2N-MID-2G-51A	ND	ND	NS	9.56	47	11.39	6.69	138.8	0.00
12/6/2010	11:05	J2N-EFF-G	J2N-EFF-G-51A	ND	ND	ND	9.58	48	11.27	6.64	138.9	0.00
1/10/2011	10:25	J2N-INF-G	J2N-INF-G-52A	ND	ND	1.16	9.25	57	11.44	7.11	179.3	0.00
1/10/2011	10:30	J2N-MID-1G	J2N-MID-1G-52A	NS	NS	ND	9.63	46	11.39	6.94	172.7	0.00
1/10/2011	10:35	J2N-MID-2G	J2N-MID-2G-52A	ND	ND	NS	9.32	53	11.29	6.8	167.8	0.00
1/10/2011	10:40	J2N-EFF-G	J2N-EFF-G-52A	ND	ND	ND	9.34	53	11.21	6.67	165.8	0.00
2/8/2011	10:00	J2N-INF-G	J2N-INF-G-53A	ND	ND	1.17	9.68	57.00	12	7.5	169.9	0
2/8/2011	10:05	J2N-MID-1G	J2N-MID-1G-53A	NS	NS	ND	9.71	49.00	12	7.07	168.6	0
2/8/2011	10:10	J2N-MID-2G	J2N-MID-2G-53A	ND	ND	NS	9.69	46.00	12	6.95	172.6	0
2/8/2011	10:15	J2N-EFF-G	J2N-EFF-G-53A	ND	ND	ND	9.69	48.00	11	6.85	170.1	0
3/7/2011	10:10	J2N-INF-G	J2N-INF-G-54A	ND	ND	1.17	9.85	52.00	11	7.88	169.2	0
3/7/2011	10:15	J2N-MID-1G	J2N-MID-1G-54A	NS	NS	ND	9.77	48.00	12	7.45	171.2	0
3/7/2011	10:20	J2N-MID-2G	J2N-MID-2G-54A	ND	ND	NS	9.69	49.00	11	7.16	170.1	0
3/7/2011	10:25	J2N-EFF-G	J2N-EFF-G-54A	ND	ND	ND	9.7	50.00	11	7	166.5	0
4/11/2011	10:30	J2N-INF-G	J2N-INF-G-55A	ND	ND	1.11	10.16	60.00	11	6.63	202.8	0
4/11/2011	10:35	J2N-MID-1G	J2N-MID-1G-55A	NS	NS	ND	9.91	59.00	12	6.57	205.8	0
4/11/2011	10:40	J2N-MID-2G	J2N-MID-2G-55A	ND	ND	NS	9.92	58.00	11	6.51	211.1	0
4/11/2011	10:45	J2N-EFF-G	J2N-EFF-G-55A	ND	ND	ND	9.89	58.00	11	6.51	210.8	0
5/9/2011	10:00	J2N-INF-G	J2N-INF-G-56A	ND	ND	1.14	10.23	61.00	11	6.64	198.2	0
5/9/2011	10:05	J2N-MID-1G	J2N-MID-1G-56A	NS	NS	ND	9.96	60.00	11	6.54	210.2	0
5/9/2011	10:10	J2N-MID-2G	J2N-MID-2G-56A	ND	ND	NS	9.99	60.00	11	6.4	216.6	0
5/9/2011	10:15	J2N-EFF-G	J2N-EFF-G-56A	ND	ND	ND	9.98	60.00	11	6.5	220.2	0
6/6/2011	10:35	J2N-INF-G	J2N-INF-G-57A	ND	ND	1.12	10.49	68.00	11	6.64	178	0
6/6/2011	10:40	J2N-MID-1G	J2N-MID-1G-57A	NS	NS	ND	10.13	61.00	11	6.54	177.8	0
6/6/2011	10:45	J2N-MID-2G	J2N-MID-2G-57A	ND	ND	NS	10.15	60.00	11	6.4	177.7	0
6/6/2011	10:50	J2N-EFF-G	J2N-EFF-G-57A	ND	ND	ND	10.18	60.00	11	6.5	179	0
7/11/2011	10:50	J2N-INF-G	J2N-INF-G-58A	ND	ND	1.15	10.99	61.00	11	6.48	140.9	0
7/11/2011	10:55	J2N-MID-1G	J2N-MID-1G-58A	NS	NS	ND	10.31	60.00	11	6.47	143.5	0
7/11/2011	11:00	J2N-MID-2G	J2N-MID-2G-58A	ND	ND	NS	10.5	60.00	11	6.48	143.4	0
7/11/2011	11:05	J2N-EFF-G	J2N-EFF-G-58A	ND	ND	ND	10.64	60.00	11	6.48	144.3	0

Legend:

RDX = Hexahydro-1,3,5-Trinitro-1,3,5-Triazine
HMX = Octahydro-1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine
µg/L = micrograms per liter (parts per billion)
ND = 0.25 µg/L for RDX and HMX; 0.35 ug/L for Perchlorate

NA = not available
NS = not sampled
Breakthrough Detected

Temp = temperature
SpC = specific conductivity
DO = dissolved oxygen
ORP = oxidation reduction potential
Turb = turbidity

°C = degrees Celsius
µS/cm = microsiemens per centimeter
mg/L = milligrams per liter (parts per million)
mV = millivolts
ntu = nephelometric turbidity units

Where duplicate sample results were available, the result presented is the average of the two samples.

Table 3-3
J2 Northern Range
Plant/System Production Summary

Plant/System	Design Flow Rate (gpm)	Average Flow Rate for Period (gpm)		Total Extracted Volume Treated (gallons)		Total Contaminant Mass Removal (pounds)			
						Perchlorate		RDX	
		Aug 10 thru July 11	Since Startup	Aug 10 thru July 11	Since Startup	Aug 10 thru July 11	Since Startup	Aug 10 thru July 11	Since Startup
Wood Road MTUs E&F	250	237	242	124,296,545	621,809,457	13.13	64.87	0.22	0.75
Jefferson Road MTU G	125	125	125	65,749,906	319,685,139	0.62	2.70	0.00	0.00
TOTAL	375	362	366	190,046,451	941,494,596	13.75	67.57	0.22	0.75

Table 3-4
J2 Range Northern RRA System Sampling Locations and Parameters for Operational Monitoring

Parameter	System Influent	MID-1 Post IX	MID-2 Post Lead GAC	System Effluent (Post Guard GAC)
Contaminants of Concern				
Perchlorate	monthly	monthly	None, until a detect at Post IX	monthly
Explosives	monthly	None	monthly	monthly
Geochemistry				
Metals, Modified; Hardness	TBD	TBD	TBD	TBD
Chloride; Sulfate; Alkalinity	TBD	TBD	TBD	TBD
Ammonia; Nitrate/Nitrite; Phosphorus	TBD	TBD	TBD	TBD
Total Organic Carbon	TBD	TBD	TBD	TBD
Total Suspended Solids (TSS)	TBD	TBD	TBD	TBD
Field Measurements				
Dissolved Oxygen	X	X	X	X
pH	X	X	X	X
Specific Conductivity	X	X	X	X
Temperature	X	X	X	X
Oxygen Reduction Potential	X	X	X	X
Turbidity	X	X	X	X

Notes:

1. X = Field measurements will be taken concurrent with all sampling events
2. TBD = To be determined: i.e., when necessary to evaluate system operations if system appears to be underperforming
3. Sampling locations, parameters and frequency will be continuously evaluated and any proposed changes will be submitted for review and approval prior to implementation

Table 4-1
J-2 Range Northern Plume Water Level Monitoring Network

Location	Northing (UTM - meters)	Easting (UTM - meters)	Ground Elevation (msl)	Screen Top Elevation (msl ft)	Screen Bottom Elevation (msl ft)
84MW0005	4619583.08	375061.78	164.22	-55.78	-60.78
J2EW1-MW1-A	4618833.09	374010.37	173.43	32.61	22.61
J2EW1-MW1-B	4618833.09	374010.77	173.43	-32.39	-42.39
J2EW1-MW1-C	4618833.49	374010.37	173.43	-67.37	-77.37
J2EW2-MW1-A	4619288.65	374193.19	181.05	37.05	27.05
J2EW2-MW3-A	4619355.15	374229.96	182.91	37.46	27.46
J2EW2-MW3-B	4619355.15	374229.56	182.91	-28.74	-38.74
J2EW2-MW3-C	4619355.65	374229.96	182.91	-63.09	-73.09
J2EW3-MW1-A	4619830.81	374386.39	182.66	37.00	27.00
J2EW3-MW1-B	4619830.81	374386.89	182.66	-28.00	-38.00
J2EW3-MW1-C	4619830.41	374386.39	182.66	-63.00	-73.00
J2EW3-MW-2-A	4619930.01	374450.02	187.53	36.37	26.37
J2EW3-MW-2-B	4619930.40	374450.02	187.53	-28.63	-38.63
J2EW3-MW-2-C	4619930.01	374450.40	187.53	-68.63	-78.63
MW-05M1	4619648.62	373613.35	184.21	-25.79	-30.79
MW-164M1	4618198.05	373303.70	180.32	-46.68	-56.68
MW-18M1	4620524.19	375347.24	102.53	-68.47	-73.47
MW-18M2	4620524.28	375347.27	102.53	-4.47	-9.47
MW-293M2	4618986.50	373993.97	173.80	-22.20	-32.20
MW-296M1	4619754.17	374180.56	186.29	-68.71	-78.71
MW-296M2	4619754.22	374180.56	186.29	-28.71	-38.71
MW-300M2	4618935.12	374097.26	171.38	-25.85	-35.85
MW-300M3	4618935.17	374097.26	171.38	36.07	26.07
MW-305M1	4618882.99	374197.58	177.60	-25.40	-35.40
MW-307M2	4617869.83	374063.94	172.86	-58.60	-68.60
MW-313M1	4619636.73	374362.91	186.42	-68.58	-78.58
MW-313M2	4619636.78	374362.91	186.42	-28.58	-38.58
MW-313M3	4619636.83	374362.91	186.42	-8.58	-18.58
MW-318M2	4619551.65	374510.27	186.01	-18.99	-28.99
MW-322M1	4618774.79	374404.12	182.46	-62.54	-72.54
MW-324M2	4618275.73	374840.08	174.08	-30.92	-40.92
MW-327M3	4620275.16	374577.99	174.97	-45.03	-55.03
MW-331M1	4619075.40	373818.49	180.22	-54.78	-64.78
MW-331M2	4619075.45	373818.49	180.22	-14.78	-24.78
MW-340M1	4620708.99	374574.33	198.65	-56.35	-66.35
MW-340M2	4620709.04	374574.33	198.65	-16.35	-26.35
MW-348M2	4619285.74	374192.17	180.61	-26.54	-36.89
MW-48M1	4620658.76	375052.66	163.04	-27.96	-37.96
MW-55D	4621020.19	374207.16	197.38	-57.62	-67.62
MW-55M1	4621020.16	374208.13	197.38	-27.62	-37.62

Table 4-2
J-2 Range Northern Plume Water Level Results and Analysis

Monitoring Well Geometries				Prior to System Startup Groundwater Elevations	2009 - 2010 Groundwater Elevations	2010 - 2011 Groundwater Elevations	2009/10 to 2010/11 Water Level Changes
Location	Ground Elevation (msl)	Screen Top Elevation (msl ft)	Screen Bottom Elevation (msl ft)	9/5/2006 (msl)	8/3/2009 (msl)	8/23/2010 (msl)	Change 8/3/09 to 8/23/10
84MW0005	164.22	(55.78)	(60.78)	68.97	**Not Measured**	70.89	**Not Measured**
J2EW1-MW1-A	173.43	32.61	22.61	72.45	70.03	75.37	5.34
J2EW1-MW1-B	173.43	(32.39)	(42.39)	72.52	69.98	75.32	5.34
J2EW1-MW1-C	173.43	(67.37)	(77.37)	72.47	69.98	75.32	5.34
J2EW2-MW1-A	181.05	37.05	27.05	71.39	68.87	74.25	5.38
J2EW2-MW3-A	182.91	37.46	27.46	71.1	68.56	73.91	5.35
J2EW2-MW3-B	182.91	(28.74)	(38.74)	70.96	68.21	73.56	5.35
J2EW2-MW3-C	182.91	(63.09)	(73.09)	70.97	68.20	73.54	5.34
J2EW3-MW1-A	182.66	37.00	27.00	69	66.05	71.30	5.25
J2EW3-MW1-B	182.66	(28.00)	(38.00)	68.99	65.67	70.89	5.22
J2EW3-MW1-C	182.66	(63.00)	(73.00)	**Not Measured**	65.50	70.74	5.24
J2EW3-MW-2-A	187.53	36.37	26.37	68.31	65.67	70.81	5.14
J2EW3-MW-2-B	187.53	(28.63)	(38.63)	68.29	65.64	70.80	5.16
J2EW3-MW-2-C	187.53	(68.63)	(78.63)	68.29	**Not Measured**	70.80	**Not Measured**
MW-05M1	184.21	(25.79)	(30.79)	70.6	67.92	73.56	5.64
MW-164M1	180.32	(46.68)	(56.68)	73.45	70.98	76.21	5.23
MW-18M1	102.53	(68.47)	(73.47)	66.32	60.85	65.16	4.31
MW-18M2	102.53	(4.47)	(9.47)	66.33	60.86	65.13	4.27
MW-293M2	173.80	(22.20)	(32.20)	72.95	69.26	74.65	5.39
MW-296M1	186.29	(68.71)	(78.71)	70.17	66.78	72.17	5.39
MW-296M2	186.29	(28.71)	(38.71)	70.33	66.88	72.29	5.41
MW-300M2	171.38	(25.85)	(35.85)	72.4	69.21	74.57	5.36
MW-300M3	171.38	36.07	26.07	72.64	69.20	74.60	5.40
MW-305M1	177.60	(25.40)	(35.40)	72.71	69.42	74.72	5.30
MW-307M2	172.86	(58.60)	(68.60)	73.78	70.91	75.65	4.74
MW-313M1	186.42	(68.58)	(78.58)	70.41	67.01	72.29	5.28
MW-313M2	186.42	(28.58)	(38.58)	70.54	67.06	72.33	5.27
MW-313M3	186.42	(8.58)	(18.58)	70.41	67.01	72.30	5.29
MW-318M2	186.01	(18.99)	(28.99)	70.33	67.12	72.33	5.21
MW-322M1	182.46	(62.54)	(72.54)	72.79	69.57	74.76	5.19
MW-324M2	174.08	(30.92)	(40.92)	73.12	69.71	74.42	4.71
MW-327M3	174.97	(45.03)	(55.03)	66.62	63.25	68.27	5.02

Table 4-2
J-2 Range Northern Plume Water Level Results and Analysis

Monitoring Well Geometries				Prior to System Startup Groundwater Elevations	2009 - 2010 Groundwater Elevations	2010 - 2011 Groundwater Elevations	2009/10 to 2010/11 Water Level Changes
Location	**Ground Elevation (msl)**	**Screen Top Elevation (msl ft)**	**Screen Bottom Elevation (msl ft)**	**9/5/2006 (msl)**	**8/3/2009 (msl)**	**8/23/2010 (msl)**	**Change 8/3/09 to 8/23/10**
MW-331M1	180.22	(54.78)	(64.78)	72.66	69.37	74.85	5.48
MW-331M2	180.22	(14.78)	(24.78)	**Not Measured**	69.43	74.94	5.51
MW-340M1	198.65	(56.35)	(66.35)	63.07	59.85	64.56	4.71
MW-340M2	198.65	(16.35)	(26.35)	63.09	59.87	64.63	4.76
MW-348M2	180.61	(26.54)	(36.89)	71.5	67.57	72.89	5.32
MW-48M1	163.04	(27.96)	(37.96)	62.99	60.09	64.47	4.38
MW-55D	197.38	(57.62)	(67.62)	61.44	58.59	63.32	4.73
MW-55M1	197.38	(27.62)	(37.62)	61.48	58.64	63.40	4.76

Bolded well names indicate the wells that were used to develop water level contour maps.

Table 4-3
J-2 Range Northern Plume Water Level Results and Vertical Gradients

Monitoring Well Geometries				Ambient Conditions		2010 Groundwater Elevations	
Location	Top of Casing Elevation (ft msl)	Screen Top Elevation (ft msl)	Screen Bottom Elevation (ft msl)	9/5/2006 (ft msl)	Vertical Gradient	8/23/2010 (ft msl)	Vertical Gradient
J2EW1-MW1-A	173.43	32.61	22.61	72.45		75.37	
J2EW1-MW1-B	173.43	(32.39)	(42.39)	72.52	+0.0011	75.32	-0.0008
J2EW1-MW1-C	173.43	(67.37)	(77.37)	72.47	-0.0014	75.32	+0.0000
J2EW2-MW3-A	182.91	37.46	27.46	71.10		73.91	
J2EW2-MW3-B	182.91	(28.74)	(38.74)	70.96	-0.0021	73.56	-0.0053
J2EW2-MW3-C	182.91	(63.09)	(73.09)	70.97	+0.0003	73.54	-0.0006
J2EW3-MW1-A	182.66	37.00	27.00	69.00		71.30	
J2EW3-MW1-B	182.66	(28.00)	(38.00)	68.99	-0.0002	70.89	-0.0063
J2EW3-MW1-C	182.66	(63.00)	(73.00)	NA	NA	70.74	-0.0043
J2EW3-MW-2-A	187.53	36.37	26.37	68.31		70.81	
J2EW3-MW-2-B	187.53	(28.63)	(38.63)	68.29	-0.0003	70.80	-0.0002
J2EW3-MW-2-C	187.53	(68.63)	(78.63)	68.29	+0.0000	70.80	+0.0000
MW-18M2	102.53	(4.47)	(9.47)	66.33		65.13	
MW-18M1	102.53	(68.47)	(73.47)	66.32	-0.0002	65.16	+0.0005
MW-296M2	186.29	(28.71)	(38.71)	NA		72.29	
MW-296M1	186.29	(68.71)	(78.71)	NA	NA	72.17	-0.0030
MW-300M3	171.38	36.07	26.07	72.64		74.60	
MW-300M2	171.38	(25.85)	(35.85)	72.40	-0.0039	74.57	-0.0005
MW-313M3	186.42	(8.58)	(18.58)	70.41		72.30	
MW-313M2	186.42	(28.58)	(38.58)	70.54	+0.0065	72.33	+0.0015
MW-313M1	186.42	(68.58)	(78.58)	70.41	-0.0033	72.29	-0.0010
MW-331M2	180.22	(14.78)	(24.78)	NA		74.94	
MW-331M1	180.22	(54.78)	(64.78)	NA	NA	74.85	-0.0023
MW-340M2	198.65	(16.35)	(26.35)	63.09		64.63	
MW-340M1	198.65	(56.35)	(66.35)	63.07	-0.0005	64.56	-0.0017
MW-55M1	197.38	(27.62)	(37.62)	61.48		63.40	
MW-55D	197.38	(57.62)	(67.62)	61.44	-0.0013	63.32	-0.0027

Notes:
ft - feet
msl - mean sea level (equivalent to zero elevation NGVD29)
NA - data not available

positive gradient denotes upward flow
negative gradient denotes downward flow

Table 5-1
J-2 Range Northern Plume Monitoring Well Results

Location	Sample Type	Analyte	Short Name	Analytical Method	Reported Result (ug/L)	Data Qualifier	Reporting Limit (ug/L)	Top of Screen (msl)	Bottom of Screen (msl)	Date
J2EW0001	N1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	-7.62	-62.62	02/14/2011
J2EW0001	N1	Perchlorate	PCATE	SW6860	17.9		1.0	-7.62	-62.62	02/14/2011
J2EW0001	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	0.50		0.21	-7.62	-62.62	02/14/2011
J2EW0001	FD1	Perchlorate	PCATE	SW6860	18.6		1.0	-7.62	-62.62	02/14/2011
J2EW0001	N1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	-7.62	-62.62	08/30/2010
J2EW0001	N1	Perchlorate	PCATE	SW6860	18.9		0.25	-7.62	-62.62	08/30/2010
J2EW0001	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	0.47		0.21	-7.62	-62.62	08/30/2010
J2EW0001	FD1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	-7.62	-62.62	08/30/2010
J2EW0001	FD1	Perchlorate	PCATE	SW6860	18.3		0.25	-7.62	-62.62	08/30/2010
J2EW0001	FD1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	0.43		0.21	-7.62	-62.62	08/30/2010
J2EW0002	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-23.92	-58.92	02/14/2011
J2EW0002	N1	Perchlorate	PCATE	SW6860	2.9		0.050	-23.92	-58.92	02/14/2011
J2EW0002	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-23.92	-58.92	08/30/2010
J2EW0002	N1	Perchlorate	PCATE	SW6860	3.2		0.050	-23.92	-58.92	08/30/2010
J2EW0003	N1	Perchlorate	PCATE	SW6860	1.2		0.050	-22.24	-52.24	02/14/2011
J2EW0003	N1	Perchlorate	PCATE	SW6860	1.1		0.050	-22.24	-52.24	08/30/2010
J2EW1-MW1-A	N1	Perchlorate	PCATE	SW6860	0.021	J	0.050	32.3	22.3	09/08/2010
J2EW1-MW1-B	N1	Perchlorate	PCATE	SW6860	9.0		0.050	-32.7	-42.7	04/01/2011
J2EW1-MW1-B	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-32.7	-42.7	09/08/2010
J2EW1-MW1-B	N1	Perchlorate	PCATE	SW6860	0.22		0.050	-32.7	-42.7	09/08/2010
J2EW1-MW1-B	FD1	Perchlorate	PCATE	SW6860	0.22		0.050	-32.7	-42.7	09/08/2010
J2EW1-MW1-C	N1	Perchlorate	PCATE	SW6860	198		5.0	-67.7	-77.7	04/01/2011
J2EW1-MW1-C	N1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	-67.7	-77.7	09/08/2010
J2EW1-MW1-C	N1	Perchlorate	PCATE	SW6860	179		5.0	-67.7	-77.7	09/08/2010
J2EW1-MW1-C	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	2.7		0.21	-67.7	-77.7	09/08/2010
J2EW1-MW1-C	FD1	Perchlorate	PCATE	SW6860	164		5.0	-67.7	-77.7	09/08/2010
J2EW2-MW1-A	N1	Perchlorate	PCATE	SW6860	0.028	J	0.050	37	27	08/31/2010
J2EW2-MW2-A	N1	Perchlorate	PCATE	SW6860	0.024	J	0.050	36.74	25.74	08/30/2010
J2EW2-MW2-B	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-28.56	-38.56	08/31/2010
J2EW2-MW2-B	N1	Perchlorate	PCATE	SW6860	0.029	J	0.050	-28.56	-38.56	08/31/2010
J2EW2-MW2-C	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-67.56	-77.56	08/30/2010
J2EW2-MW2-C	N1	Perchlorate	PCATE	SW6860	0.062		0.050	-67.56	-77.56	08/30/2010
J2EW2-MW3-A	N1	Perchlorate	PCATE	SW6860	0.042	J	0.050	37.66	27.66	09/07/2010
J2EW2-MW3-B	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-28.54	-38.54	09/07/2010
J2EW2-MW3-B	N1	Perchlorate	PCATE	SW6860	21.7		0.50	-28.54	-38.54	09/07/2010
J2EW2-MW3-B	FD1	Perchlorate	PCATE	SW6860	21.8		0.50	-28.54	-38.54	09/07/2010
J2EW2-MW3-C	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-62.84	-72.84	09/07/2010
J2EW2-MW3-C	N1	Perchlorate	PCATE	SW6860	0.023	J	0.050	-62.84	-72.84	09/07/2010
J2EW3-MW-2-A	N1	ND for 1 Analytes	Perchlorate	SW6860	ND	U	ND	36.55	26.55	08/26/2010
J2EW3-MW-2-B	N1	Perchlorate	PCATE	SW6860	0.020	J	0.050	-28.45	-38.45	02/15/2011
J2EW3-MW-2-B	N1	ND for 1 Analytes	Perchlorate	SW6860	ND	U	ND	-28.45	-38.45	08/26/2010
J2EW3-MW-2-C	N1	Perchlorate	PCATE	SW6860	1.4		0.050	-63.45	-73.45	08/26/2010
MW-130D	N1	Perchlorate	PCATE	SW6860	0.034	J	0.050	-146.04	-156.04	09/02/2010
MW-130M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	13.99	3.99	09/02/2010
MW-130M1	N1	Perchlorate	PCATE	SW6860	0.39		0.050	13.99	3.99	09/02/2010

Table 5-1
J-2 Range Northern Plume Monitoring Well Results

Location	Sample Type	Analyte	Short Name	Analytical Method	Reported Result (ug/L)	Data Qualifier	Reporting Limit (ug/L)	Top of Screen (msl)	Bottom of Screen (msl)	Date
MW-130S	N1	2-Amino-4,6-Dinitrotoluene	A2DNT46	SW8330	0.14	J	0.21	70.96	60.96	09/02/2010
MW-130S	N1	4-Amino-2,6-Dinitrotoluene	A4DNT26	SW8330	0.89		0.21	70.96	60.96	09/02/2010
MW-130S	N1	ND for 15 Analytes	Explosives	SW8330	ND	U	ND	70.96	60.96	09/02/2010
MW-130S	N1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	0.28	J	0.21	70.96	60.96	09/02/2010
MW-130S	N1	Perchlorate	PCATE	SW6860	0.20		0.050	70.96	60.96	09/02/2010
MW-130S	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	0.15	J	0.21	70.96	60.96	09/02/2010
MW-229M1	N1	ND for 1 Analytes	Perchlorate	SW6860	ND	U	ND	-108.05	-118.05	08/24/2010
MW-229M2	N1	Perchlorate	PCATE	SW6860	0.040	J	0.050	-28.02	-38.02	08/24/2010
MW-229M3	N1	Perchlorate	PCATE	SW6860	0.070		0.050	36.98	26.98	08/24/2010
MW-229M4	N1	Perchlorate	PCATE	SW6860	0.041	J	0.050	61.12	51.12	08/24/2010
MW-230M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	41.71	31.71	09/01/2010
MW-230M1	N1	Perchlorate	PCATE	SW6860	0.59		0.050	41.71	31.71	09/01/2010
MW-230M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	61.67	51.67	09/01/2010
MW-230M2	N1	Perchlorate	PCATE	SW6860	0.11		0.050	61.67	51.67	09/01/2010
MW-234M1	N1	2-Amino-4,6-Dinitrotoluene	A2DNT46	SW8330	4.0		0.21	43.44	33.44	08/25/2010
MW-234M1	N1	4-Amino-2,6-Dinitrotoluene	A4DNT26	SW8330	3.9		0.21	43.44	33.44	08/25/2010
MW-234M1	N1	1,3-Dinitrobenzene	DNB13	SW8330	0.19	J	0.21	43.44	33.44	08/25/2010
MW-234M1	N1	2,4-Dinitrotoluene	DNT24	SW8330	0.35		0.21	43.44	33.44	08/25/2010
MW-234M1	N1	ND for 12 Analytes	Explosives	SW8330	ND	U	ND	43.44	33.44	08/25/2010
MW-234M1	N1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	2.4	J	0.21	43.44	33.44	08/25/2010
MW-234M1	N1	Perchlorate	PCATE	SW6860	0.33		0.050	43.44	33.44	08/25/2010
MW-234M1	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	2.1		0.21	43.44	33.44	08/25/2010
MW-234M1	N1	2,4,6-Trinitrotoluene	TNT	SW8330	0.70		0.21	43.44	33.44	08/25/2010
MW-234M2	N1	2-Amino-4,6-Dinitrotoluene	A2DNT46	SW8330	6.7		0.21	63.51	53.51	08/25/2010
MW-234M2	N1	4-Amino-2,6-Dinitrotoluene	A4DNT26	SW8330	6.0		0.21	63.51	53.51	08/25/2010
MW-234M2	N1	2,4-Dinitrotoluene	DNT24	SW8330	0.35		0.21	63.51	53.51	08/25/2010
MW-234M2	N1	ND for 14 Analytes	Explosives	SW8330	ND	U	ND	63.51	53.51	08/25/2010
MW-234M2	N1	Perchlorate	PCATE	SW6860	0.16		0.050	63.51	53.51	08/25/2010
MW-234M2	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	0.17	J	0.21	63.51	53.51	08/25/2010
MW-234M2	N1	2,4,6-Trinitrotoluene	TNT	SW8330	2.0		0.21	63.51	53.51	08/25/2010
MW-234M2	FD1	2-Amino-4,6-Dinitrotoluene	A2DNT46	SW8330	6.9		0.21	63.51	53.51	08/25/2010
MW-234M2	FD1	4-Amino-2,6-Dinitrotoluene	A4DNT26	SW8330	6.1		0.21	63.51	53.51	08/25/2010
MW-234M2	FD1	2,4-Dinitrotoluene	DNT24	SW8330	0.39		0.21	63.51	53.51	08/25/2010
MW-234M2	FD1	ND for 14 Analytes	Explosives	SW8330	ND	U	ND	63.51	53.51	08/25/2010
MW-234M2	FD1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	0.17	J	0.21	63.51	53.51	08/25/2010
MW-234M2	FD1	2,4,6-Trinitrotoluene	TNT	SW8330	2.1		0.21	63.51	53.51	08/25/2010
MW-289M1	N1	ND for 17 Analytes	Explosives	SW8330	ND	U	ND	-137.01	-147.01	08/24/2010
MW-289M1	N1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	0.83		0.21	-137.01	-147.01	08/24/2010
MW-289M1	N1	Perchlorate	PCATE	SW6860	0.62		0.050	-137.01	-147.01	08/24/2010
MW-289M1	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	0.44		0.21	-137.01	-147.01	08/24/2010
MW-289M2	N1	ND for 17 Analytes	Explosives	SW8330	ND	U	ND	6.63	-3.37	08/24/2010
MW-289M2	N1	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-	HMX	SW8330	3.0		0.21	6.63	-3.37	08/24/2010
MW-289M2	N1	Perchlorate	PCATE	SW6860	2.8		0.050	6.63	-3.37	08/24/2010
MW-289M2	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	2.0		0.21	6.63	-3.37	08/24/2010
MW-289S	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	63.59	53.59	08/24/2010
MW-289S	N1	Perchlorate	PCATE	SW6860	0.025	J	0.050	63.59	53.59	08/24/2010
MW-293M1	N1	Perchlorate	PCATE	SW6860	0.0078	J	0.050	-122.99	-132.99	08/25/2010

Table 5-1
J-2 Range Northern Plume Monitoring Well Results

Location	Sample Type	Analyte	Short Name	Analytical Method	Reported Result (ug/L)	Data Qualifier	Reporting Limit (ug/L)	Top of Screen (msl)	Bottom of Screen (msl)	Date
MW-293M2	N1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	-23.39	-33.39	08/25/2010
MW-293M2	N1	Perchlorate	PCATE	SW6860	1.2		0.050	-23.39	-33.39	08/25/2010
MW-293M2	N1	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	RDX	SW8330	0.24		0.20	-23.39	-33.39	08/25/2010
MW-293M2	FD1	Perchlorate	PCATE	SW6860	1.3		0.050	-23.39	-33.39	08/25/2010
MW-293S	N1	Perchlorate	PCATE	SW6860	0.032	J	0.050	63.04	53.04	08/25/2010
MW-296M1	N1	Perchlorate	PCATE	SW6860	0.17		0.050	-69.44	-79.44	08/24/2010
MW-296M2	N1	Perchlorate	PCATE	SW6860	0.039	J	0.050	-29.43	-39.43	08/24/2010
MW-300M1	N1	ND for 1 Analytes	Perchlorate	SW6860	ND	U	ND	-122.24	-132.24	09/08/2010
MW-300M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-26.39	-36.39	09/08/2010
MW-300M2	N1	Perchlorate	PCATE	SW6860	0.45		0.050	-26.39	-36.39	09/08/2010
MW-300M3	N1	Perchlorate	PCATE	SW6860	0.030	J	0.050	35.28	25.28	09/08/2010
MW-302M1	N1	Perchlorate	PCATE	SW6860	0.012	J	0.050	-123.56	-133.56	09/02/2010
MW-302M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-17.58	-27.58	09/02/2010
MW-302M2	N1	Perchlorate	PCATE	SW6860	0.041	J	0.050	-17.58	-27.58	09/02/2010
MW-305M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-25.75	-35.75	08/25/2010
MW-305M1	N1	Perchlorate	PCATE	SW6860	0.25		0.050	-25.75	-35.75	08/25/2010
MW-313M1	N1	Perchlorate	PCATE	SW6860	0.078		0.050	-68.98	-78.98	02/15/2011
MW-313M1	N1	Perchlorate	PCATE	SW6860	0.083		0.050	-68.98	-78.98	09/07/2010
MW-313M2	N1	Perchlorate	PCATE	SW6860	5.5		0.50	-28.98	-38.98	02/15/2011
MW-313M2	N1	Perchlorate	PCATE	SW6860	6.1		0.050	-28.98	-38.98	09/07/2010
MW-313M2	FD1	Perchlorate	PCATE	SW6860	6.0		0.050	-28.98	-38.98	09/07/2010
MW-313M3	N1	Perchlorate	PCATE	SW6860	0.023	J	0.050	-9.01	-19.01	02/15/2011
MW-313M3	N1	Perchlorate	PCATE	SW6860	0.035	J	0.050	-9.01	-19.01	09/07/2010
MW-318M1	N1	Perchlorate	PCATE	SW6860	0.032	J	0.050	-119.38	-129.38	09/07/2010
MW-318M2	N1	Perchlorate	PCATE	SW6860	0.034	J	0.050	-19.35	-29.35	09/07/2010
MW-322M1	N1	Perchlorate	PCATE	SW6860	0.076		0.050	-63.48	-73.48	02/14/2011
MW-322M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-63.48	-73.48	08/26/2010
MW-322M1	N1	Perchlorate	PCATE	SW6860	0.39		0.050	-63.48	-73.48	08/26/2010
MW-327M1	N1	ND for 1 Analytes	Perchlorate	SW6860	ND	U	ND	-120.74	-130.74	09/08/2010
MW-327M2	N1	Perchlorate	PCATE	SW6860	0.14		0.050	-90.77	-100.77	09/10/2010
MW-327M3	N1	Perchlorate	PCATE	SW6860	0.043	J	0.050	-45.78	-55.78	02/14/2011
MW-327M3	N1	Perchlorate	PCATE	SW6860	0.043	J	0.050	-45.78	-55.78	09/10/2010
MW-330M2	N1	ND for 1 Analytes	Perchlorate	SW6860	ND	U	ND	-50.97	-60.97	09/02/2010
MW-331M1	N1	Perchlorate	PCATE	SW6860	0.022	J	0.050	-55.27	-65.27	08/30/2010
MW-331M2	N1	Perchlorate	PCATE	SW6860	0.0089	J	0.050	-15.28	-25.28	08/30/2010
MW-337M1	N1	Perchlorate	PCATE	SW6860	0.14		0.050	-55.33	-65.33	02/14/2011
MW-337M1	N1	Perchlorate	PCATE	SW6860	0.11		0.050	-55.33	-65.33	09/02/2010
MW-340M1	N1	Perchlorate	PCATE	SW6860	0.014	J	0.050	-56.62	-66.62	09/08/2010
MW-340M2	N1	Perchlorate	PCATE	SW6860	0.030	J	0.050	-16.62	-26.62	09/08/2010
MW-345M2	N1	Perchlorate	PCATE	SW6860	0.015	J	0.050	-51.6	-61.6	09/02/2010
MW-348M2	N1	Perchlorate	PCATE	SW6860	0.028	J	0.050	-26.81	-36.81	08/31/2010

Table 5-1
J-2 Range Northern Plume Monitoring Well Results

Location	Sample Type	Analyte	Short Name	Analytical Method	Reported Result (ug/L)	Data Qualifier	Reporting Limit (ug/L)	Top of Screen (msl)	Bottom of Screen (msl)	Date
MW-366M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-62.84	-72.84	09/30/2010
MW-366M1	N1	Perchlorate	PCATE	SW6860	1.0		0.050	-62.84	-72.84	09/30/2010
MW-366M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-22.86	-32.86	09/30/2010
MW-366M2	N1	Perchlorate	PCATE	SW6860	0.38		0.050	-22.86	-32.86	09/30/2010
MW-366M3	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	7.11	-2.89	09/30/2010
MW-366M3	N1	Perchlorate	PCATE	SW6860	0.043	J	0.050	7.11	-2.89	09/30/2010
MW-381M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-55.21	-65.21	09/15/2010
MW-381M1	N1	Perchlorate	PCATE	SW6860	0.058		0.050	-55.21	-65.21	09/15/2010
MW-381M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	-18.14	-28.14	09/15/2010
MW-381M2	N1	Perchlorate	PCATE	SW6860	0.012	J	0.050	-18.14	-28.14	09/15/2010
MW-63M1	N1	Perchlorate	PCATE	SW6860	0.027	J	0.050	-29	-39	09/07/2010
MW-63M2	N1	Perchlorate	PCATE	SW6860	0.021	J	0.050	0.92	-9.08	09/07/2010

N1 - Normal Sample
FD1 = Duplicate Sample
ND = Non-detect

U = Non-Detect
J = Estimated

Table 6-1
J-2 Range Northern Plume Measured and Predicted Perchlorate Concentrations

Name	Perchlorate (µg/L)		Deviation
	Measured	Predicted	(Measured/Predicted)
J2EW1-MW1-A	0.02	0.00	N/A
J2EW1-MW1-B	9.00	39.02	**434%**
J2EW1-MW1-C	198.00	1.69	**1%**
J2EW2-MW1-A	0.03	0.00	N/A
J2EW2-MW2-A	0.02	0.00	N/A
J2EW2-MW2-B	0.03	0.42	N/A
J2EW2-MW2-C	0.06	7.77	N/A
J2EW2-MW3-A	0.04	0.00	N/A
J2EW2-MW3-B	21.70	0.81	**4%**
J2EW2-MW3-C	0.02	3.60	N/A
J2EW3-MW-2-A	0.00	0.00	N/A
J2EW3-MW-2-B	0.02	0.12	N/A
J2EW3-MW-2-C	1.40	0.61	N/A
MW-130D	0.03	0.00	N/A
MW-130M1	0.39	0.00	N/A
MW-130S	0.20	0.00	N/A
MW-229M1	0.00	0.00	N/A
MW-229M2	0.04	0.00	N/A
MW-229M3	0.07	0.19	N/A
MW-229M4	0.04	0.04	N/A
MW-230M1	0.59	0.04	N/A
MW-230M2	0.11	0.00	N/A
MW-234M1	0.33	0.29	N/A
MW-234M2	0.16	0.02	N/A
MW-289M1	0.62	2.89	N/A
MW-289M2	2.80	1.47	**53%**
MW-289S	0.03	0.01	N/A
MW-293M1	0.01	0.14	N/A
MW-293M2	1.20	2.61	N/A
MW-293S	0.03	0.00	N/A
MW-296M1	0.17	1.16	N/A
MW-296M2	0.04	0.11	N/A
MW-300M1	0.00	0.00	N/A
MW-300M2	0.45	10.46	N/A
MW-300M3	0.03	0.00	N/A
MW-302M1	0.01	0.00	N/A
MW-302M2	0.04	0.35	N/A
MW-305M1	0.25	0.85	N/A
MW-313M1	0.08	0.03	N/A
MW-313M2	6.10	2.84	**46%**
MW-313M3	0.04	0.30	N/A
MW-318M1	0.03	0.00	N/A
MW-318M2	0.03	0.07	N/A
MW-322M1	0.39	0.00	N/A
MW-327M1	0.00	0.00	N/A
MW-327M2	0.14	0.25	N/A
MW-327M3	0.04	1.84	N/A
MW-330M2	0.00	0.00	N/A
MW-331M1	0.02	0.09	N/A
MW-331M2	0.01	0.00	N/A
MW-337M1	0.14	0.30	N/A
MW-340M1	0.01	0.00	N/A
MW-340M2	0.03	0.00	N/A
MW-345M2	0.02	0.00	N/A
MW-348M2	0.03	0.81	N/A
MW-63M1	0.03	0.00	N/A
MW-63M2	0.03	0.00	N/A

Notes:
N/A - concentration less than 2 ug/L and deviation not calculated.
Red is under-prediction and green is over-prediction.

APPENDIX A

Impact Area Groundwater Study Program
Responses to US Environmental Protection Agency Protection Comments on the Draft J-2 Range Eastern and Northern Interim Environmental Monitoring Reports
August 2010 through July 2011
Dated: December 2011

EPA REVIEW OF RESPONSE TO COMMENTS ON DRAFT J-2 RANGE EASTERN INTERIM ENVIRONMENTAL MONITORING REPORT (DATED APRIL 26, 2012)

GENERAL COMMENTS

1) Please update the plume shell using data through 2011 and after addressing these comments.

Response: The goal of the annual report is to document current conditions in light of historic trends and to make recommendations necessary to optimize the system. The recommendation of whether or not to develop an updated plume shell is considered to be a result of the evaluation and not part of the annual report. The comparison between the measured and predicted J2 Eastern plume remain in reasonable agreement using the existing perchlorate and RDX plume shells. Therefore, the J2 Eastern plume shells are not recommended for updating at this point; however, the need for plume shell updates will continue to be evaluated during the development of future annual reports.

Additional Comment: EPA does not concur that the existing plume shells remain in reasonable agreement with the measured concentrations and believes that a recommendation of this monitoring report should be to update the eastern plume shells using all currently available data. Please edit the report accordingly. Given that the Army is in the process of completing the Feasibility Study for the J-2 Range plumes, now is an appropriate time to update the plume shells and to confirm the viability of the hydraulic modeling and contaminant transport before a remedy is selected for the site. Therefore, EPA reiterates the comments made on these topics in its original comment submittal for the 2010-2011 monitoring report. Subsequently, for future monitoring reports and to facilitate future decision-making, predicted and actual contaminant concentrations should be presented in tabular form for each well screen to demonstrate the continued validity of the transport model. Please note that the PME plan states that chemical data will be evaluated periodically and the evaluations will include identification of contaminant trends upgradient and downgradient of the extraction wells, and remapping of plume geometry and mass distribution (reassessment of plume isocontours).

Resolution: A recommendation will be added to the J-2 Range Eastern annual report to update the perchlorate and RDX plume shells.

SPECIFIC COMMENTS

7) Pg 4-1, §4.2 - The Final J-2 Range Eastern System Performance Monitoring Plan (page 5.3) specifies that "potentiometric maps for the aquifer at selected depth intervals will be constructed and compared against model predictions to ensure that observed performance is within the range of conditions during the design simulation testing." Only one potentiometric map for a single interval between +8.74 feet and -124.38 feet msl was prepared for each monitoring event and presented as Figures 4-2 and 4-3. The depth interval over which the screens of the wells used for developing these potentiometric surfaces is large (133.12 feet). Generally, there appears to be several wells within this interval at each cluster available for use in developing the potentiometric surface. Although water level data from either the M1 or M2 wells within a cluster are generally used for contouring, the basis for selecting a particular well at a specific location is unclear. Frequently, the water levels measured within a cluster varying sufficiently to impact the contouring of the potentiometric surface. Under such conditions, the development of multiple potentiometric surfaces may provide the most reliable means for evaluating the hydraulic response of the aquifer to the extraction system. Potentiometric levels for more discrete intervals should be prepared and used to evaluate the hydraulic performance to the extraction system.

Response: The evaluation in the annual report includes water levels from depths selected to represent the approximate location of the perchlorate plume. The following sentence will be added following the fourth sentence in the third paragraph of Section 4.2: "The well screens selected for use in the development of a potentiometric surface generally coincide with elevations of the perchlorate and RDX plumes".

In addition, there is no comparison between observed water levels and those predicted by the model. Without this comparison, it is not possible to evaluate and confirm the ability of the model to accurately represent the hydraulic system under current conditions. Please provide a comparison between predicted and observed water levels during the current monitoring period. This comparison should include a tabular presentation of predicted and observed water levels at each of the monitoring wells where water levels are collected. In addition, depictions of predicted and observed potentiometric surfaces should be provided for comparison. Any significant differences between predicted and observed water levels should be identified and the potential impact of residual errors on the model reliability evaluated. Comparisons of predicted and observed water levels at multiple depths should be included in this evaluation.

Response: The flow model, being used to support the perchlorate and RDX simulations, represents "average" flow field conditions based on historic data and simulated during the development of the RI/FS for the J2 Range. The only change to the flow model that is made from year-to-year is an update of the well file so that the pumping stress applied to the model is accurate. Therefore, it is expected that from one year to the next the flow model will either over or under predict measured conditions but in the long term the coupled flow and transport model will provide reliable predictions of perchlorate and RDX, provided that the plume shell is regularly updated to reflect the measured conditions. Therefore, discrepancies between measured and predicted water levels are expected and a well-by-well comparison of measured and predicted water levels will not add significant value and are not recommended.

Additional Comment: The monitoring report should be revised to include the language suggested in the response. The approach being followed to depict potentiometric contours based on a single water level elevation within the plume will generally provide a suitable depiction of potentiometric contours for evaluating capture in those areas where limited vertical gradients exist. While this appears to generally be the case within the main portion of the J-2 Range eastern plume, there is an area upgradient of J2EW0005 where the plume has migrated both above and below a silt layer (see Figure 5-2). The water-level data indicate potentially significantly different water level elevations in this area (MW-368M1/M2). In lieu of preparing separate potentiometric maps, the

text should discuss the impact of these differences in water level elevations relative to the depiction of potentiometric contours and the capture of the plume in this area. The text should discuss the development of the potentiometric map and an evaluation of plume capture in any other area where significant vertical gradients exist.

The response also indicates that the model is only intended to predict average hydraulic conditions. The response also further indicates that discrepancies between measured and predicted water levels during any specific monitoring event are expected. However, the model is being used during each monitoring event to evaluate capture and to project the migration of contaminants during each individual monitoring event. Such evaluations and predictions can only be deemed reliable for any specific time period if the model is demonstrated to be a reliable representation of hydraulic behavior and contaminant migration. Before the Feasibility Study is completed, the IAGWSP needs to demonstrate that the hydraulic model for the site is still accurate. In order to demonstrate that, the IAGWSP will need to compare the model predictions and measured values for the site water level data with appropriate adjustments for baseline conditions. Deviations of the modeled water levels from the expected water level ranges should be minimized by recalibrating the model if necessary. Please edit the report to recommend that the hydraulic modeling be verified and calibrated as necessary prior to completing the Feasibility Study.

Resolution: The text will be updated by adding the following sentences to Section 4.2: “The flow model, being used to support the perchlorate and RDX simulations, represents “average” flow field conditions based on historic data and simulated during the development of the RI/FS for the J2 Range. The only change to the flow model that is made from year-to-year is an update of the well file so that the pumping stress applied to the model is accurate. Therefore, it is expected that from one year to the next the flow model will either over or under predict measured conditions but in the long term the coupled flow and transport model will provide reliable predictions of perchlorate and RDX, provided that the plume shell is appropriately updated to reflect the measured conditions. Therefore, discrepancies between measured and predicted water levels are expected and a well-by-well comparison of measured and predicted water levels will not add significant value”.

See response to Specific Comment #12. Significant gradients do not exist anywhere around the site with the exception of in the immediate vicinity of the extraction wells, primarily because of the relatively low rate of groundwater extraction in this very productive aquifer, which is why the model is being primarily used to determine capture zones for evaluation.

A recommendation will be made to re-evaluate and re-calibrate the flow model during the development of the RI/FS for the J-2 Range.

8) Pg 4-1, §4.2 - The Final J-2 Range Eastern System Performance Monitoring Plan (page 5.3) specifies that “long-term (hydraulic) monitoring measurements will be compiled as hydrographs and analyzed for trends in water level changes.” However, no hydrographs have been included in the Interim Environmental Monitoring Report. Please include in the monitoring report a set of hydrographs for monitoring locations and depths that are representative of the changes in groundwater levels observed throughout the site.

Response: The long term trends in water levels agreed to in the J-2 Eastern System Performance Monitoring Plan has been understood to refer to regional water levels at groundwater level monitoring stations maintained by the USGS. A description of the regional water level trends is provided in paragraph 2 of Section 4.3. Hydrographs were created for the five wells used to evaluate long term water level trends and were used to develop the description provided in Section 4.3. The water level data for the five wells can be found at the following web addresses, which will be included in Section 4.3:

- http://waterdata.usgs.gov/nwis/dv/?site_no=414124070311401&agency_cd=USGS&referred_module=gw

- http://waterdata.usgs.gov/nwis/dv/?site_no=414139070311501&agency_cd=USGS&referred_module=gw

- http://waterdata.usgs.gov/nwis/dv/?site_no=414159070310501&agency_cd=USGS&referred_module=gw

- http://waterdata.usgs.gov/nwis/dv/?site_no=414219070313601&agency_cd=USGS&referred_module=gw

Additional Comment: Links were provided for only four wells not five as stated; however, it appears that there are only four appropriate USGS wells in Barnstable County. If a fifth well was also used please identify it. Please include the relevant USGS water level data in an appendix to the monitoring report and in that appendix discuss in appropriate detail how the comparison was made between the regional water level changes and the site water level changes and the significance of any differences. Also, it would be helpful if a figure were provided which illustrates the location of each of the USGS wells. EPA notes that all four USGS wells are located on the opposite side of the groundwater mound from the J-2 plumes in an area with multiple ponds; therefore, it is not clear that these USGS wells are representative of J-2 Range groundwater fluctuations.

Resolution: There are only four wells that have been used to monitor long term water levels, not five. Therefore, “five” will be changed to “four”. In addition, the following text will be added to Section 4.3: “The four USGS wells provide a detailed history of groundwater levels near the top of the regional groundwater mound. The USGS wells are superior to using J-2 Range monitoring wells because of their long data history and frequency of data collection (every 15 minutes), while water level data at the J-2 Range wells are collected just a few times per year”

9) Pg 4-2, §4.2 - Comparison of the potentiometric contours depicted in Figures 4-2 and 4-3 with the specific water level measurements identified on these figures indicates that there may be an error in contouring. In Figure 4-3, the measured water level at J2MW-04M1 is shown to be 71.34 ft. However, the 70.8 foot contour is drawn immediately adjacent to this well. With a contour interval of 0.2 feet, the 70.8 foot contour appears to be significantly misplaced at this location. The potentiometric contouring in this area of the site should be reexamined and re-contoured as appropriate.

Response: There water level at well J2MW-04M1 was not used in the data contouring and should not have been bolded in the figure. This will be corrected by un-bolding the well name J2MW-04M1 in Figure 4-3.

Additional Comment: It is irrelevant whether or not Army used J2MW-04M1 for contouring water levels; the fact is that the water level at this well is inconsistent with the contours provided indicating that the flow field is not correct. Review of both current and prior water level data for both J2MW-04M1 and M2 indicate that the levels and changes are consistent with the water levels and changes for other wells so that the water levels at J2MW-04M1 and M2 are not anomalous. It appears that the contours connecting J2EW0006 and J2EW0005 are incorrect and should be redrawn, possibly independent of one another. Adequate justification for omitting these data from the development of the potentiometric map should be provided, or the contours should be redrawn to adequately reflect these data.

Resolution: The water level at J2MW-04M1 should have been used in the initial contouring and will

be added back to the dataset so that the groundwater contours can be contoured correctly.

10) Pg 4-1, §4.2 - The monitoring report concludes that "overall, the flow field analysis indicates that gradients are generally in the direction of the extraction wells at the plume elevation." However, examination of the potentiometric surfaces presented in Figures 4-2 and 4-3 indicates that there may be a significant area of bypass immediately to the east and south of monitoring well cluster MW-215. The discussion of the flow field analysis should be revised to acknowledge this potential concern.

Response: The potential problem will be recognized by adding the following sentence immediately prior to the last sentence in the fourth paragraph of Section 4.2: "The only exception to the flow of contaminated groundwater being toward the extraction wells is in the area of well MW-215 where elevated groundwater levels suggest flow toward the northeast".

Additional Comment: Please provide and explanation for this observation and predicted outcomes.

Resolution: The following sentence will be added prior to the last sentence in the last paragraph of Section 4.2: "Groundwater level contours in the area of well MW-215 are a reflection of drawdown at the J2EW0004 extraction well and even though the plume southeast of this well is not anticipated to be captured, groundwater modeling indicates that it will attenuate to a perchlorate concentration of less than 2 µg/L by 2015." The affect of the elevated groundwater level on contaminant transport will be further evaluated in the RI/FS for the J-2 Range"

12) Pg 4-2, §4.4 - The Final J-2 Range Eastern System Performance Monitoring Plan (page 5.3) specifies that "vertical gradients will be tabulated" and that "changes in vertical gradients in well clusters will be evaluated." The environmental monitoring report does not include a tabulation of vertical gradients at each well cluster, nor does it include an evaluation of changes in vertical gradients. The report merely states that "the vertical gradient analysis indicated in the 2009 annual report is assumed to continue to represent the vertical flow component of groundwater flow during the current evaluation period." Adequate justification is not provided for this assumption. Given the recent regional changes in water levels, the tabulation and evaluation of vertical gradients specified in the System Performance and Evaluation Plan should be provided in the current monitoring report. Any deviations from the conceptual model or simulated range of performance should be identified and evaluated for their impact on system performance.

Response: A tabular summary of calculated vertical gradients will be developed and described and both the text and table will be added to Section 4.2 of the report.

The evaluation of vertical gradients and capture zones in the vertical direction would also be facilitated by the preparation of cross-sections similar to those presented for contaminant concentrations in the monitoring report, but with measured water levels identified for each monitoring well rather than contaminant concentration. The preparation of such cross section is recommended.

Response: All of the water level data is presented in the potentiometric maps and throughout the report and reworking the same data into additional data tables and figures is not necessary to evaluate vertical differences in piezometric heads.

Additional Comment: Please provide the proposed text discussing this data for review.

Resolution: The following text will be added to Section 4.4:
"Water levels among the well clusters were used to calculate the vertical gradients within the J-2 Eastern monitoring network. The table presents vertical gradients within the J-2 Eastern plume monitoring network. The Table presents the vertical gradients for the two semi-annual synoptic

events obtained during the reporting period and includes baseline (non-pumping) and operational conditions. The results indicate that the extraction wells have had the desired effect on the aquifer system. The hydraulic gradient changes at the near-field wells (J2MW05M1, M2, J2MW-02M1, M2, PZ, J2MW-01M1, M2, MW-393D, M1, M2, J2MW-03M2, and PZ) showed either reverse or enhanced flow in the direction of the extraction well screens in response to pumping. The hydraulic gradients exhibited at wells farther from the extraction wells did not change significantly between the ambient and the operational condition. The vertical gradient analysis for the site-wide monitoring network only provides very limited insight into the system performance, partly because of the highly conductive nature of the aquifer system and the significantly aquifer thickness relative to the pumping interval."

14) Pg 5-2, Section § 5.1.1, par 5 – It is indicated that concentrations detected at J2MW-05M2 are indicative of continued vertical thinning of the plume. EPA notes that concentrations may continue to be detected from this monitoring well because it is located within the capture zone of J2EW0004.

Response: Noted.

Additional Comment: The EPA's observation regarding the contaminant concentration detected at J2MW-05M2 resulting from the wells location within the capture of J2EW0004 has been noted in the response. However, it would be helpful to include this potential explanation for the contaminant concentrations detected at J2MW-05M2 in the text of the current and future annual monitoring reports.

Resolution: The following sentence will be added to Section 5.1.1:
"Perchlorate concentrations may continue to be detected at J2MW-05M2 because this monitoring well is located within the capture zone of J2EW0004"

15) Pg 6-1, §6.1 - A comparison of model predicted and perchlorate concentration observed during the winter 2011 monitoring event is presented in Figure 6-1. A similar comparison of model predicted and RDX concentrations is provided in Figure 6-2. However, due to the rather broad concentration ranges used in these figures, particularly for perchlorate, it is very difficult to compare the actual and predicted contaminant concentration values based on the information presented in these figures. Moreover, the concentration contours (outlines) presented in the depiction of observed conditions appears to be based on projected historical data as well as current measurements. These figures also are one-dimensional and do not depict the predicted and observed vertical distribution of contaminants.

To facilitate the comparison of predicted and observed contaminant concentrations, the actual predicted concentration at each monitoring well should be shown on the depiction of predicted conditions. Similarly, the actual observed concentration at each monitoring well should be shown on the depiction of observed conditions. In addition, please provide tables presenting predicted and measured perchlorate and RDX concentration values at each monitoring well where contaminant concentrations are measured. The enhanced figures and additional tables will facilitate the comparison of predicted and observed values of contaminant concentrations and allow for a more thorough evaluation of the reliability of the transport model and the continued suitability of the current plume shells. The adequacy of the model and current plume shell should be reevaluated using the enhanced figures and additional tables.

Response: The point-by-point comparison of measured and predicted concentrations is not believed to be a valuable or reliable evaluation of the J2 model's predictive ability as a whole. It is clear that based on a cursory overview of the figures that there are several locations where measured and predicted concentrations would be in disagreement for a variety of reasons including, but not limited to, a flow model that is representative of average rather than actual conditions, and a relatively limited number of data points, with plumes developed by projecting

measurements forward rather than having actual measurements. The annual report is meant to present the measured and predicted plumes to provide for an evaluation of the general shape and magnitude of concentrations and a point-by-point comparison is believed to be outside the scope of an annual report. The contour levels shown in Figures 6-1 and 6-2 are believed to adequately represent the predictive capacity of the model and no changes will be made.

Additional Comment: The comment acknowledges that there are already several locations where the observed and model predicted contaminant concentrations are in disagreement. This is in spite of the response to General Comment No. 1 which states that the comparison between the measured and predicted J2 Eastern plume remains in reasonable agreement using the existing perchlorate and RDX shells. In reality, it is very difficult to determine the extent of the agreement between predicted and observed contaminant concentrations without a direct comparison of predicted and observed contaminant concentrations at each sampling location. The development and presentation of a simple table providing the predicted and observed perchlorate and RDX concentrations at each monitoring location and depth should be a relatively easy matter. Such a tabular display would greatly facilitate the evaluation of the extent of agreement between model predictions and observed contaminant concentration values. While the response to General Comment No. 1 indicates that the need for plume shell updates will continue to be evaluated during the development of future annual reports, the methodology for such an evaluation has not been provided. Such an evaluation should include the tabular comparison of predicted and observed contaminant concentration values and should be presented beginning with the current Environmental Monitoring Report.

Resolution: A tabular comparison of measured and predicted perchlorate and RDX concentrations will be developed and included within the report.

19) Pg 6-4, §6.2 **-** The text states that '"results of the transport evaluation indicated that the system is meeting the basis of design," and that "particle tacking in the model was used to develop the predicted system capture zone under current operating conditions (Figure 6-5). However, as noted above, an evaluation to verify that the flow model can reliably represent the hydraulic regime under current conditions has not been provided. Moreover, the potentiometric contours depicted Figure 6-5 do not correspond well with those depicted for the current monitoring events in Figures 4-2 and 4-3. The general shape of the potentiometric surfaces differ significantly. Most notably, the potentiometric surface depicted in Figure 6-5 does not show the area of potential bypass observed to the east and south of MW-215 cluster. In addition, the water levels depicted in Figure 6-5 range between 64.5 ft. and 67.5 ft. msl, while the water level shown for September 2010 monitoring event and depicted in Figure 4-2 range between 71.6 ft. and 75.6 ft msl. Similarly the water levels shown for the March 2011 monitoring event and depicted in Figure 4-3 range between 69.4 ft. and 73.2 ft msl. Thus, it does not appear that the predicted capture zone presented in Figure 6-5 was developed using current operating conditions.

Particle tracking used to predict and evaluate the system capture zone under current operating conditions should be based on a model that predicts closely the current hydraulic conditions in the area J-2 Range eastern plume. Prior to using the particle tracking for this purpose, the model should be recalibrated as necessary to reproduce these conditions. The ability of the model to accurately predict groundwater levels under current conditions should be clearly demonstrated.

Response: See response to Specific Comment #7.

Additional Comment: The response to Specific Comment No. 7 indicates that the groundwater model is calibrated to average conditions and accordingly will provide reliable predictions of capture over the long-term. The reliability of model predictions to demonstrate capture over the long-term may eventually be demonstrated. However, the model is currently being used to

evaluate capture under current conditions by superimposing the capture zones predicted based on a calibration to average condition over the currently observed distribution of contamination. As note in the original comment, the predicted and observed potentiometric surfaces do not match well in a number of locations. These discrepancies between observed and predicted water levels indicate that the capture zone predicted by the model may not provide a reliable demonstration of capture under current conditions. This potential uncertainty should be acknowledged in the text. It is further recommended that, until the reliability of the model is demonstrated, an analysis of the potentiometric contours developed from current water level data provide the principal means of evaluating capture during each individual monitoring event. Please also refer to EPA's comment on the response to SC #7.

Resolution: The following sentence will be added to Section 6.2:
"Discrepancies between observed and predicted water levels indicate that the capture zone predicted by the model on a year over year basis may not provide a reliable demonstration of capture under current conditions but over the long term the capture zone predicted by the model is believed to adequately represent capture using the current extraction system." An evaluation will also be provided in the RI/FS for the J-2 Range.

21) Pg 7-1, Section § 7.4 – Please continue to monitor MW-357M1, MW-358M1, and MW-57D at the frequencies previously specified.

Response: Disagree with continuing to monitor and would like to discuss.

Additional Comment: MW-357M1, MW-57D, and MW-358M1 are situated cross- or downgradient of uncaptured portions of the plume. MW-57D is sampled annually, and MW-357M1 and MW-358M1 are sampled biennially. These wells should be retained until this portion of the plume is predicted to have or measured to have attenuated. It has also been recently noted that a significant area of bypass may exist immediately to the east and south of monitoring well cluster MW-215.

Resolution: Will continue to monitor MW-357M1, MW-358M1, and MW-57D at the frequencies previously specified.

23) Figure 5-6 - Please add a note indicating the date of the perchlorate detections identified by the colored circles.

Response: A note will be added to Figure 5-6 to indicate that the perchlorate detections identified by the colored circles are the maximum measured during the reporting period. A note will also be added to Figure 5-12 to indicate that the RDX detections identified by the colored circles are the maximum measured during the reporting period.

To make the use of the colored circles more informative it would be appropriate to add another concentration level and associated color such as less than 0.5 µg/L or another lower appropriate value.

Response: The colored symbol scheme has been established for all reports and has been in place for several years and no changes are recommended.

More appropriate concentration ranges should be used for the individual well graphs to make the presentation of the perchlorate concentrations more informative relative to the cleanup goal of 2.0 µg/L.

Response: Concentration ranges will be updated to better represent the lower concentration measurements.

Additional Comment: If the scale of the trend graphs adequately identifies the well concentrations then no change in the legend will be required.

Resolution: Agreed.

25) 5-12 - Please add a note indicating the date of the RDX detections identified by the colored circles.

Response: The addition of dates to the colored circles would place too much information on an already crowded figure and obscure the well names, which are considered to be more important. This is especially true since concentrations were all measured within the same 12 month period. The concentrations indicated were all measured during the reporting period described in this annual report and the exact sampling dates are included in tables. No changes are recommended.

To make the use of the colored circles more informative it would be appropriate to add another concentration level and associated color such as greater than 2.0 µg/L or another lower appropriate value.

Response: See response to comment #23.

A more appropriate concentration range should be used for the individual well graphs to make the presentation of the RDX concentrations more informative relative to the criteria of concern (0.6 µg/L and 2.0 µg/L).

Response: Concentration ranges will be updated to better represent the lower concentration measurements.

Additional Comment: If the scale of the trend graphs adequately identifies the well concentrations then no change in the legend will be required.

Resolution: Agreed.

26) Figure 6-5 – EPA notes that the eastern and western detached lobes for perchlorate are not fully captured by the extraction system. Army should clearly demonstrate that the contamination not captured by the extraction wells will attenuate within an appropriate timeframe.

Response: The sentence “The perchlorate concentrations in the western detached lobe are predicted to be diminished to less than 2 µg/L in 2011 and in the eastern detached lobe are predicted to be diminished to less than 2 µg/L in 2015. “ will be added to Section 6.2 to describe the simulated reduction in perchlorate concentrations. The measured plume outlines in Figures 1-2, 2-1, 4-1, 4-2, 4-3, 5-1, 5-6, 6-1, and 6-5 will be modified to reflect the reduction in plumelet size.

Additional Comment: When demonstrating that the detached lobes that are not captured by the extraction system will attenuate within an appropriate time frame, the Army should provide validation of model predictions with actual observed data to indicate that model predictions are sufficiently reliable to support their conclusion. Such an evaluation can be performed through comparison with observed and predicted contaminant concentrations over time at nearby locations. Otherwise, the Army should provide the necessary monitoring data to demonstrate the attenuation of contaminants in the detached lobes. For comparison, because of the limited amount of data available for the detached lobes, please also provide an alternative projection if the bypassed concentration is one order of magnitude greater than Army’s estimate.

Resolution: The potential for migration of the plumelets east and west of the main J-2 Eastern plume will be further evaluated through sensitivity testing in the RI/FS for the J-2 Range.

EPA REVIEW OF RESPONSE TO COMMENTS ON DRAFT J-2 RANGE NORTHERN INTERIM ENVIROMENTAL MONITORING REPORT (DATED APRIL 26, 2012)

GENERAL COMMENTS

1) Please update the plume shell using data through 2011 and after addressing these comments. Consideration should be given to additional well installation downgradient of J2EW0001 to determine whether any contamination may be bypassing the extraction well.

   Response: The goal of the annual report is to document current conditions in light of historic trends and to make recommendations necessary to optimize the system. The recommendation presented in Section 7.2 of the final report will be expanded to include a potential update to the plume shell, if needed. A separate project note work plan will be prepared, outlining the work needed to determine if optimization of extraction well operations is warranted.

   Additional Comment: Given that the Army is planning additional investigation to assess the need for optimization of the extraction system, please include that as a recommendation of this monitoring report. Also, because the Army is in the process of completing the Feasibility Study for the J-2 Range plumes EPA requests that this monitoring report include a recommendation to update the northern plume shells using all available data. EPA believes that this needs to be done irrespective of the findings of the proposed supplemental investigation and not as a contingency. The update should be performed following the completion of the proposed supplemental investigation and before completing the Feasibility Study. Please edit the report accordingly.

   Resolution: A recommendation will be added to the J-2 Range Northern annual report to conduct additional investigation and to optimize the system based on the results of the additional investigation. A recommendation will also be added to the J-2 Range Northern annual report to update the plume shells for perchlorate and RDX following the completion of the proposed supplemental investigation.

2) The Project Note to be prepared for potential system optimization (see Specific Comments) should also include potential increase of the flow rate in J2EW0003 to capture currently uncaptured portions of the perchlorate plume.

   Response: The plume downgradient from extraction well J2EW0003 is predicted to attenuate to perchlorate concentrations less than 2 µg/L within a few years and recent groundwater data from J2EW3-MW-1-C and J2EW3-MW-2-C as well as MW-337M1 MW-327M1/2 support this prediction. Figures throughout the final annual report will be updated to better reflect this by drawing a smaller plume downgradient of well J2EW0003 and no change to the pumping rate is recommended.

   Additional Comment: It is not apparent from this response or from information in the annual report what the basis is for “drawing a smaller plume downgradient of well J2EW0003.” If this refers to updating figures to include the most recent groundwater data, it is not clear why that wasn’t done in the first place. Also, Army’s projections for time to cleanup are apparently based on very limited data supplemented with assumptions for the concentration of perchlorate in the bypassed plume; however, it is not apparent that Army has adequate characterization data to reliably estimate the perchlorate concentration. Please provide the basis for Army’s projection of time to cleanup for this bypassed plume and also provide an alternative projection if the bypassed concentration is one order of magnitude greater than Army’s estimate.

   Resolution: The plume in the area downgradient of extraction well J2EW0003 will be further evaluated through sensitivity testing in the RI/FS for the J-2 Range.

SPECIFIC COMMENTS

6) Pg 4-1, §4.2 - The Final J-2 Northern Rapid Response Action System Performance and Evaluation Plan (page 5.3) specifies that “long-term (hydraulic) monitoring measurements will be compiled as hydrographs and analyzed for trends in water level changes.” However, no hydrographs have been included in the Interim Environmental Monitoring Report. Please include in the monitoring report a set of hydrographs for monitoring locations and depths that are representative of the changes in groundwater levels observed throughout the site.

   Response: The long term trends in water levels agreed to in the J-2 Eastern System Performance Monitoring Plan have been understood to refer to regional water levels at groundwater monitoring stations maintained by the USGS. A description of the regional water level trends is provided in paragraph 2 of Section 4.3. Hydrographs were created for the five wells used to evaluate long term water level trends and were used to develop the description provided in Section 4.3. The water level data for the five wells can be found at the following web addresses, which will be included in Section 4.3:

   - http://waterdata.usgs.gov/nwis/dv/?site_no=414124070311401&agency_cd=USGS& referred_module=gw
   - http://waterdata.usgs.gov/nwis/dv/?site_no=414139070311501&agency_cd=USGS& referred_module=gw
   - http://waterdata.usgs.gov/nwis/dv/?site_no=414159070310501&agency_cd=USGS& referred_module=gw
   - http://waterdata.usgs.gov/nwis/dv/?site_no=414219070313601&agency_cd=USGS& referred_module=gw

   Additional Comment: Links were provided for only four wells not five as stated; however, it appears that there are only four appropriate USGS wells in Barnstable County. If a fifth well was also used please identify it. Please include the relevant USGS water level charts in an appendix to the monitoring report and in that appendix discuss in appropriate detail what the basis is for concluding that there was no significant difference between the regional water level changes and the site water level changes.

   Resolution: The following text will be added to Section 4.3 to indicate the superiority of the USGS wells for tracking regional water levels: “The four USGS wells provide a detailed history of groundwater levels near the top of the regional groundwater mound. The USGS wells are superior to using J-2 Range monitoring wells because of their long data history and frequency of data collection (every 15 minutes) while the water level data at the J-2 Range wells are collected just a few times per year”

7) Pg 4-1, §4.2 - The Final J-2 Northern Rapid Response Action System Performance and Evaluation Plan (page 5.3) specifies that “potentiometric maps for the aquifer at selected depth intervals will be constructed and compared against model predictions to ensure that observed performance is within the range of conditions during the design simulation testing.” Only one potentiometric map for a single interval between -3.98 and -58.98 feet msl was prepared and presented as Figure 4-2. Potentiometric maps for other intervals, most notably, the shallow water table zone should be prepared and presented. Moreover, there is no comparison between predicted and observed water levels. Without this comparison, it is not possible to evaluate and confirm the ability of the model to accurately represent the

hydraulic system under current conditions. Please provide a comparison between predicted and observed water levels during the current monitoring period. This comparison should include a tabular presentation of predicated and observed water levels at each of the monitoring wells where water levels are collected. In addition, depictions of predicted and observed potentiometric surfaces should be provided for comparison. Any significant differences between predicted and observed water levels should be identified and the impact on model reliability evaluated. Comparisons of predicated and observed water levels at multiple depths should be included in this evaluation.

Response: The flow model, being used to support the perchlorate and RDX simulations, represents “average” flow field conditions based on historic data and simulated during the development of the RI/FS for the J2 Range. The only change to the flow model that is made from year-to-year is an update of the well file so that the pumping stress applied to the model is accurate. Therefore, it is expected that from one year to the next the flow model will either over or under predict measured conditions but in the long term the coupled flow and transport model will provide reliable predictions of perchlorate and RDX, provided that the plume shell is regularly updated to reflect the measured conditions. Therefore, discrepancies between measured and predicted water levels are expected and a well-by-well comparison of measured and predicted water levels will not add value to the report.

Additional Comment: The response indicates that the model is only intended to predict average hydraulic conditions. The response also further indicates that discrepancies between measured and predicted water levels during any specific monitoring event are expected. However, the model is being used during each monitoring event to evaluate capture and to project the migration of contaminants during each individual monitoring event. Such evaluations and predictions keep only be deemed reliable for any specific time period if model is demonstrated to be a reliable representation of hydraulic behavior and contaminant migration. In the absence of such a demonstration, the text should acknowledge the uncertainty in the model prediction and the evaluation of capture and contaminant migration should be based on the water-level and groundwater quality data collected during the reported monitoring event(s) (see Specific Comment No. 19). Before the Feasibility Study is completed, Army needs to demonstrate that the hydraulic model for the site is still accurate. In order to demonstrate that, Army will need to compare the model predictions and measured values for the site water level data with appropriate adjustments for baseline conditions. Deviations of the modeled water levels from the expected water level ranges should be minimized by recalibrating the model if necessary. Please edit the report to recommend that the hydraulic modeling be verified and calibrated as necessary prior to completing the Feasibility Study. For each subsequent monitoring event, the associated report should present predicted versus observed water levels in tabular format to demonstrate that the model continues to represent actual conditions.

Resolution: The EMR will be revised by adding the following text to the first paragraph of Section 6.1:

“The flow model represents “average” flow field conditions based on historic data and simulated during the development of the RI/FS for the J-2 Range. The only change to the flow model that is made from year-to-year is an update of the well file so that the pumping stress applied to the model is accurate. Therefore, it is expected that from one year to the next the flow model will either over or under predict measured conditions but in the long term the coupled flow and transport model will provide reliable predictions. Therefore, discrepancies between measured and predicted water levels are expected. Based on the current period data the model is likely over predicting water levels around the site.

8) Pg 4-2, §4.2 - The monitoring report concludes that “overall, the flow field analysis indicates that gradients are generally in the direction of the extraction wells at the plume elevation.” However,

examination of the potentiometric surface presented in Figure 4-2 indicates that there may be a significant area of bypass immediately to the east of extraction well J2EW003. The discussion of the flow field analysis should be revised to acknowledge this potential issue.

Response: The last sentence of the third paragraph of Section 4.2 will be modified by adding ", with the exception of the area immediately north and east of well J2EW0003. The perchlorate plume in this area though is predicted to be diminished to concentrations less than 2 µg/L by 2013. Therefore, even if some portion of the perchlorate plume is not captured in this area the concentrations will attenuate". The small plume downgradient of J2EW0003 should be smaller than drawn and will be reduced in size to coincide with predictions. Figures 1-3, 3-2, 4-1, 4-2, 5-1, 5-2, 5-3, 6-1 and 6-4 will be updated to reflect this decreasing plume size.

Additional Comment: Please delete the last newly proposed sentence. Please compare this cleanup estimate to the estimation of cleanup timeframes and maximum extent of perchlorate migration at 2 µg/L downgradient of J2EW0003 in the RRA workplan. Also, see the response to GC-2 with respect to the conceptualization of the plume downgradient of J2EW0003.

Resolution: The sentence "Therefore, even if some portion of the perchlorate plume is not captured in this area the concentrations will attenuate" will NOT be added. In addition, as noted in the resolution to GC #2, concerns regarding perchlorate concentrations downgradient of J2EW0003 will be addressed in the RI/FS.

10) Pg 4-2, §4.3 - The Final J-2 Northern Rapid Response Action System Performance and Evaluation Plan (page 5-3) specifies that "vertical gradients will be tabulated" and that "changes in vertical gradients in well clusters will be evaluated." The environmental monitoring report does not include a tabulation of vertical gradients at each well cluster, nor does it include an evaluation of changes in vertical gradients. The report merely states that "the vertical gradient analysis indicated in the 2009 annual report is assumed to continue to represent the vertical flow component of groundwater flow during the current evaluation period." No justification is provided for this assumption. Given the recent regional changes in water levels, the tabulation and evaluation of vertical gradients specified in the System Performance and Evaluation Plan should be provided in the current monitoring report. Any deviations from the conceptual model or simulated range of performance should be identified and evaluated for their impact on system performance.

Response: A tabular summary of calculated vertical gradients will be developed and described and both the text and table will be added to Section 4.2 of the report.

Additional Comment: EPA has received the table of vertical gradients. Please provide the proposed text discussing this data for review.

Resolution: The following text will be added to Section 4.2: "Water levels among the well clusters were used to calculate the vertical gradients within the J-2 Northern monitoring network. The table presents vertical gradients within the J-2 Northern Range monitoring network. The Table presents the vertical gradients for the annual synoptic event obtained during the reporting period and includes baseline (non-pumping) and operational conditions. The results indicate that the extraction wells have had the desired effect on the aquifer system. The hydraulic gradient changes at the near-field wells (J2EW1-MW1-A, B, C, J2EW2-MW3-A, B, C, J2EW3-MW1-A, B, and C) generally showed either reversed or enhanced flow in the direction of the extraction well screens in response to pumping. The hydraulic gradients exhibited at wells farther from the extraction wells did not change significantly between the ambient and the operational condition. The vertical gradient analysis for the site-wide monitoring network only provides very limited insight into the system performance, partly because of the highly conductive nature of the aquifer system and the significantly aquifer thickness relative to the pumping interval"

11) Pg 5-1, §5.1 – Please edit the text to reconcile the apparent discrepancy between the discussion in the first paragraph of this section, which refers to releases from multiple locations over several decades, with the first sentence in Section 5.1.1, which states that there is primarily a single source of contamination.

    Response: This is not a discrepancy. Section 5.1 refers to the J2 Range as a whole while Section 5.1.1 refers to the J2 Range Northern, specifically. No text changes are recommended.

    Additional Comment: The response is not correct. The first paragraph in Section 5.1 is only discussing the Northern plume and the text specifically states that the plume resulted from releases at multiple locations. Please correct the discrepancy between the two referenced paragraphs in EPA's original comment.

    Resolution: The word "locations" will be replaced with the word "times" in the last sentence of the first paragraph of Section 5.1.

13) Pg 5-2, §5.1.1 - The second full paragraph on the page appears to contain contradictory information. The first sentence states that contaminant concentrations have trended higher immediately downgradient of J2EW001; however, the second sentence presents information for J2EW-MW-1-B indicating a decrease in concentration and the second last sentence states that concentrations have continued to decline at all MW-300 series wells (located immediately downgradient of J2EW0001). Concentrations at J2EW-MW-1-C, a deeper well, have significantly increased, possibly indicating a plunging plume. Please rewrite this paragraph to clarify the characterization of the plume and eliminate the apparent inconsistencies. Please provide a detailed discussion of the trending higher concentrations detected at J2EW-MW-1-C. EPA notes that the screens at the MW-300 location may not be appropriately placed to detect any contamination potentially migrating beyond J2EW0001.

    Response: The sentence in the second paragraph will be revised to "The perchlorate concentration in the monitoring wells located immediately downgradient of the J2EW0001 extraction well have trended higher. The perchlorate concentration at J2EW-MW-1-B, downgradient of the mid-depth of the J2EW0001 extraction well screen has increased to 9.0 µg/L (April 2011) from 7.01 µg/L (August 2009) and the concentration at J2EW-MW-1-C, downgradient and slightly deeper than the bottom of the J2EW0001 well screen has increased to 198 µg/L (April, 2011) from 13.9 µg/L (August 2009), suggesting that the core of the plume extends slightly deeper than observed during the remedial investigation. Additional work is recommended to further evaluate this portion of the plume."

    The discussion in the third full paragraph should be edited because it is not apparent that a change in concentration from ND with a reporting limit of 1 µg/L to a concentration of less than 0.1 µg/L is a decrease. It would be appropriate to mention that a reduction in the detection levels was achieved for the most recent data as compared to historical data.

    Response: The paragraph will be rewritten for clarification to:

    "Perchlorate concentrations in the central lobe of the plume and upgradient of the J2EW0002 extraction well are decreasing as evidenced by a continued reduction in perchlorate concentrations at this well since startup. The perchlorate plume downgradient of this extraction well is defined by monitoring wells MW-348, J2EW-MW-1 and J2EW-MW-2. Perchlorate concentrations at MW-348M2 have decreased to 0.0277J µg/L (August, 2010) from a high of 51.6 µg/L in July 2005. Concentrations at J2EW-MW-2-A, B and C were measured to be 0.0237J µg/L, 0.0292J µg/L and 0.062 µg/L (August, 2010); however, since concentrations at these wells were previously reported as ND, at a reporting limit of 1 µg/L, it is not possible to determine a trend in the data."

Additional Comment: EPA has received Army's re-submittal of Figure 5-2 dated 1/6/2012 which shows two lobes with concentrations greater than 200 µg/L immediately upgradient of J2EW0001 in response to the detection of perchlorate at 198 µg/L at well screen J2EW1-MW1-C. Please indicate if this second 200 µg/L lobe was added without rekriging the data. Army has proposed further investigation of the plume upgradient of J2EW0001 to better define the plume configuration and concentrations. While two separate lobes are possible as shown in the resubmitted figure, the actual plume configuration can only be determined by the additional field investigation proposed. Although the resubmitted Figure 5-2 shows 2010 operating conditions; Army has stated that the final Figure 5-2 should be revised to depict 2011 operating conditions.

Replace "are" with "have been" in the newly re-written paragraph beginning: "Perchlorate concentrations in the central lobe of the plume…" Concentrations may begin to rise again in the future depending upon the concentrations originally located between J2EW0001 and J2EW0002. Please label the wells as J2EW2-MW-1-A instead of J2EW-MW-1, and J2EW2-MW-2-A,B,C instead of J2EW-MW-2.

No response has been provided to the concern that the screens at the MW-300 location may not be appropriately placed to detect any contamination potentially migrating beyond J2EW0001. EPA noted this same concern in the prior year comments, IAGWSP indicated that the M2 screens were believed to be directly in line with the most elevated upgradient perchlorate and RDX concentrations are were considered to be in a good position to indicate the effectiveness of well J2EW001 at capturing contamination. This may or may not be true if higher concentrations are migrating laterally through J2EW0001 and potentially under-flowing the capture zone. Please note this concern and add that this concern will be addressed through implementation of the J-2 Range Northern Plume J2EW001 Evaluation.

Resolution: The following sentence will be added to Section 5.0: "Cross-sections were not created using any statistical contouring software but rather using water quality and flow information and model predictions to interpret distributions"

The legend will be changed to indicate that "2011" conditions are reflected instead of "2010" conditions.

The word "are" will be replaced with "have been" in the newly re-written paragraph beginning: "Perchlorate concentrations in the central lobe of the plume…" Concentrations may begin to rise again in the future depending upon the concentrations originally located between J2EW0001 and J2EW0002.

Wells will be labeled as J2EW2-MW-1-A instead of J2EW-MW-1, and J2EW2-MW-2-A,B,C instead of J2EW-MW-2.

The second to last sentence of the third paragraph of Section 5.1.1 will be amended by adding the phrase "...perchlorate <u>at the mid-screen elevation</u> has not migrated…" The sentences "However, elevated perchlorate concentrations recently measured at the J2EW1-MW1-C screen and potentially migrating beyond the J2EW0001 capture zone may not be represented downgradient by either the MW-300M2 or MW-300M3 screens because of the elevation differences (Figure 5-2). Additional investigation downgradient of the J2EW0001 extraction well is recommended to insure that capture of the elevated perchlorate concentrations in the J2EW1-MW1-C screen is achieved." will be added following the amended sentence.

14) Pg 5-2, § 5.1.1, par 4 – It is indicated that perchlorate concentrations in the central lobe of the plume and upgradient of the J2EW0002 extraction well are decreasing as evidenced by a continued reduction

in perchlorate concentrations at this well since startup. Please discuss whether perchlorate concentrations are expected to rise in the future based upon the detection of perchlorate at 115 µg/L from MW-300M2 in January 2006.

Response: This was not discussed because it is evident in Figure 5-2 that the 2-200 µg/L perchlorate concentrations have largely migrated through the J2EW0002 capture zone and are currently being captured. The sentence “Perchlorate concentrations are not expected to increase at well J2EW0002 in the future because it is believed that, given the predicted travel times, the highest perchlorate concentrations have already migrated to the extraction well” will be added following the first sentence section header ““Central Lobes from Wood Road to J2EW0003” in Section 5.1.1.

Additional Comment: IAGWSP noted that it is evident that the 2-200 µg/L perchlorate concentrations have largely migrated through the J2EW0002 capture zone and are currently being captured. It is proposed that the following description be added to the report: “Perchlorate concentrations are not expected to increase at well J2EW0002 in the future because it is believed that, given the predicted travel times, the highest perchlorate concentrations have already migrated to the extraction well.” EPA noted this same concern in a prior year annual report. IAGWSP responded then that the elevated perchlorate concentrations measured at MW-300M2 during 2004 through 2007 are predicted to be just recently reaching J2EW0002 and are expected to increase as extraction continues drawing the plume toward the extraction well. EPA notes that concentrations have not continued to increase at J2EW0002. Please explain this discrepancy in responses, and provide a re-evaluation of capture if appropriate.

Resolution: The concentrations were expected to increase and the reason that they have not may be a result of a plume shell that needs updating. See IGWSP resolution response to GC#1. Any potential discrepancies will be resolved as necessary in the RI/FS.

15) Pg 5-2, § 5.1.1, par 5 – Please explain why perchlorate concentrations have remained fairly consistent from J2EW2-MW-3-B rather than exhibiting declining concentrations due to the influx of water behind J2EW0002.

Response: This may be simply because monitoring well J2EW2-MW3-B is so close to the stagnation point downgradient of the J2EW0002 extraction well and not moving at an appreciable velocity. No changes to the document are recommended.

Additional Comment: Please add the potential explanation for the contaminant behavior at J2EW2-MW3-B to the text of the report. Please describe whether the J2EW0001evaluation or potential future optimization should take this stagnation into account.

Resolution: The following sentence will be added to Section 5.1.1 paragraph 5: “Perchlorate concentrations at monitoring well J2EW2-MW-3-B have remained elevated at 15-20 µg/L, which may be because the monitoring well is so close to the stagnation point downgradient of the J2EW0002 extraction well and not moving at an appreciable velocity. Low perchlorate concentrations at MW-348M1/M2 and at J2EW2-MW2-A/B/C tend to support the idea that concentrations are remain elevated at J2EW2-MW3-B because of stagnation; however, further efforts will be conducted to evaluate the likelihood and potential impact of stagnation”.

16) Pg 5-3, § 5.1.1 – Please discuss the results from MW-327. Please change the sampling frequency at MW-327M2 to semi-annually due to increasing concentrations.

Response: See response to GC #2, above. Perchlorate at MW-327M2 has only been measured once (0.135 µg/L) using method SW6860, with a detection limit of 0.05 µg/L, during the reporting period. The most recent value of 0.718 µg/L was collected in September 2011, which is outside of

the monitoring period described in this report but is consistent with model predictions of some downgradient migration of this detached portion of the plume as it attenuates, and all detected concentrations to date are well within drinkable levels. Therefore, annual sampling at MW-327M2 is adequate for the current monitoring purpose. If future detections show increasing trends above and beyond model predictions a change in sampling frequency may be warranted.

Additional Comment: Please refer to EPA's comment on the response for GC#2.

Resolution: Recommend continued annual sampling. See IGWSP resolution response to GC#2.

20) Pg 6-1, § 6.1.1 - Please edit the first sentence to read: "…perchlorate plume is somewhat similar to the model ...." Please edit this report to discuss why the differences noted are not enough to justify an upgrade of the model prior to completing the RI/FS.

Response: The first sentence in Section 6.1.1 will be modified to "…perchlorate plume is somewhat similar to the model ....and width but displaying clearer segmentation and a slightly deeper core in the upgradient area than was known at the time the current plume shell was developed." Additional field work is being planned to evaluate capture of the upgradient segment of the plume at J2EW0001 and optimization of the system and plume shell may follow. The recommendation in section 7.2 of the Annual Report will be expanded include development of a project note briefly describing the additional field work.

Additional Comment: Please refer to EPA's comment on the response for GC#1.

Resolution: See IGWSP resolution response to GC#1.

22) Pg 6-1, §6.1.1 - Due to the rather broad concentration ranges used in the contouring of perchlorate concentration in Figure 6-1 (2-15 µg/l, 15-200 µg/l, and greater than 200 µg/l), it is very difficult to compare the actual predicted and observed contaminant concentration at each monitoring well. Please provide a table presenting predicted and measured perchlorate concentration values at each monitoring well where contaminant concentrations are measured. Such a table will facilitate the comparison of predicted and observed values and allow for a more thorough evaluation of the reliability of the transport model. Based on concentration values presented in this table, the monitoring report should provide a more detailed assessment of the reliability of the transport model.

Response: Comparison of model predicted versus observed plumes is intentionally qualitative in scope and, as such, is adequate to identify divergences of significance to the performance of the ETR system. A well by well tabulation will add unnecessary detail that does not provide a significant value to this comparison over the graphic depictions that are included in all annual reports. It is clear, based on a cursory overview of the figures, that there are several locations where measured and predicted concentrations would be in disagreement for a variety of reasons including, but not limited to, a flow model that is representative of average rather than annual conditions, and a relatively limited number of data points, with plumes developed by projecting measurements forward rather than having actual measurements. That is why a new plume shell is being recommended for the J2 Northern area. The contour levels shown in Figures 6-1 and 6-2 are believed to adequately represent the predictive capacity of the model and no changes are recommended.

Additional Comment: EPA concurs that a new plume shell is warranted for the Northern plume. Please refer to EPA's comment on the response to GC#1 and SC#7. Based on completion of the efforts described in GC#1 and SC#7, Army may forego including the well by well concentrations in this monitoring report but should plan to included them in support of the model verification when the revisions for GC#1 and SC#7 are made.

Resolution: Agreed.

23) Pg 6-2, § 6.1.1, par 4 – Please explain why model predicted concentrations are consistently greater than the measured concentrations at J2EW0002.

Response: The following sentence will be added to the end of the fourth paragraph of Section 6.1.1: "The predicted perchlorate concentrations at well J2EW0002 may be consistently greater than measured concentrations because of an over estimation of the mass of perchlorate in the area between J2EW0001 and J2EW0002, which was estimated using historic concentrations from the MW-293 monitoring wells".

Additional Comment: It is described by IAGWSP that the predicted perchlorate concentrations at well J2EW0002 may be consistently greater than measured concentrations because of an over estimation of the mass of perchlorate in the area between J2EW0001 and J2EW0002. Please discuss whether the predicted concentrations at well J2EW0002 may be consistently greater than measured concentrations because some amount of mass may be bypassing the capture zone to the well. In addition, this response appears to contradict the response provided to MassDEP SP-9. Please clarify. Please explain whether the cumulative influent concentrations detected from J2EW0002 over the operating history are reflective of the concentrations formerly seen at Wood Road.

Resolution: The sentence "However, the measured concentrations of perchlorate at the MTUs would likely be better predicted using an updated plume shell, which is being recommended as part of this EMR evaluation" will be added to Section 6.1.1.

24) Pg 6-2, § 6.1.1, par 6 – Please explain why the model significantly under predicts the mass removed at each of the three extraction wells for the reporting period.

Response: The following text will be added to the end of the last paragraph of Section 6.1.1: ", likely because of the higher than anticipated measured perchlorate concentrations being extracted by the J2EW0001 well and seen at the J2EW1-MW1 monitoring wells".

Additional Comment: The response did not provide an explanation as to why the model under-predicted the mass removed at J2EW0002 and J2EW0003.

Resolution: The following sentence will be added to Section 6.1.1: "However, the measured mass of perchlorate at the MTUs would likely be better predicted using an updated plume shell, which is being recommended as part of this EMR evaluation".

In addition, the following sentence will be added after the second paragraph of Section 6.1.1: "It is important to recognize when evaluating the measured and predicted extracted perchlorate concentration and mass that while extracted concentrations are measured at each of the three extraction wells (J2EW0001, J2EW0002 and J2EW0003) the extracted masses are measured at the MTUs E & F and MTU G, where MTUs E & F represent extracted concentrations from J2EW0001 and J2EW0002 and MTU G represents extracted mass from J2EW0003".

25) Pg 6-2, §6.1.2 - The results of particle tracking generated using the groundwater flow model developed for the J-2 Ranges are presented in Figure 6-4 and used to evaluate system capture under current conditions. However, as noted above, an evaluation to verify that the flow model can reliably represent the hydraulic regime under current conditions has not been provided. Hydraulic conditions, most notably water levels and pumping stresses, have recently changed. No discussion has been provided regarding how these changes have been accommodated in the current model. Prior to accepting the

evaluation of system capture based on particle tracking using the flow model, the monitoring report should provide a detailed discussion of any modifications to the model to accommodate recent changes in hydraulic conditions. The ability of the model to accurately predict groundwater levels under current conditions must be demonstrated.

Response: See response to Specific Comment #7.

Additional Comment: The response to Specific Comment No. 7 indicates that the groundwater model is calibrated to average conditions and accordingly will provide reliable predictions of capture over the long-term. The reliability of model predictions to demonstrate capture over the long-term may eventually be demonstrated. However, the model is currently being used to evaluate capture under current conditions by superimposing the capture zones predicted based on a calibration to average conditions over the currently observed distribution of contamination. As noted in the original comment, the predicted and observed potentiometric surfaces do not match well in a number of locations. These discrepancies between observed and predicted water levels indicate that the capture zone predicted by the model may not provide a reliable demonstration of capture under current conditions. This potential uncertainty should be acknowledged in the text. It is further recommended that, until the reliability of the model is demonstrated, an analysis of the potentiometric contours developed from current water level data provide the principal means of evaluating capture during each individual monitoring event. Please refer to EPA's comment on the response for SC#7.

Resolution: See response to resolution of Specific Comment #7.

26) Pg 6-2, §6.1.2 - As acknowledged in this section, the results of particle tracking presented in Figure 6-4 indicate that the easternmost portion of the plume slightly east of MW-313 is outside the capture zone created by J2EW0003. An evaluation of the potentiometric surface developed using current water level measurements and presented in Figure 4-2 similarly indicates that capture is not occurring east of J2EW0003. Consideration should be given to further system optimization to increase capture in this area.

Response: The last two sentences in the first paragraph of Section 6.2 will be replaced with the sentence "Model predictions indicate that the uncaptured perchlorate plume in the area slightly east of MW-313 and downgradient of J2EW0003 will attenuate to concentrations less than 2 µg/L in 2013".

Additional Comment: When demonstrating that the detached lobes that are not captured by the extraction system will attenuate within an appropriate time frame, the Army should provide validation of model predictions with actual observed data to indicate that model predictions are sufficiently reliable to support their conclusion. Such an evaluation can be performed through comparison with observed and predicted contaminant concentrations over time at nearby locations. Otherwise, the Army should provide the necessary monitoring data to demonstrate the attenuation of contaminants in the detached lobes. For comparison, because of the limited amount of data available for the detached lobes, please also provide an alternative projection if the bypassed concentration is one order of magnitude greater than Army's estimate.

Resolution: See resolution to specific comment #8

30) Pg 7-1, §7.4, Recommendations – Please continue to monitor MW-366M1 and MW-381M1 at the frequencies previously specified.

Response: Clarification is requested from the EPA as to the necessity of continuing to monitor MW-366M1 and MW-381M1.

Additional Comment: MW-366M1 and MW-381M1 were removed from the chemical monitoring program as a result of recommendations in the last annual report. Please clarify.

Resolution: MW-366M1 and MW-381M1 will remain out of the monitoring program.

37) Figure 6-1 - There are significant differences between the model-predicted conditions and the observed conditions depicted in this figure. Please edit this report, perhaps in the recommendations section, to discuss why the differences are not enough to justify an upgrade of the model prior to completing the RI/FS.

Response: see response to comment #19, above.

Please provide a more detailed description in the text as to how the observed winter 2011 conditions were developed given that the model results presented in this figure have significant differences from the observed results.

Response: see response to comment #19, above.

Additional Comment: Please refer to EPA's comment on the response for GC#1.

Resolution: See response to resolution GC#1.